

## **FINAL**

### **FINDING OF NO SIGNIFICANT IMPACT AND FINDING OF NO PRACTICABLE ALTERNATIVE**

#### **STORMWATER DRAINAGE PROJECT F.E. WARREN AIR FORCE BASE WYOMING**

#### **DECISION**

It is my decision to approve the Proposed Action as described in the Stormwater Drainage Project Environmental Assessment (EA), which is attached and incorporated by reference. Proposed improvements to the existing stormwater drainage system on F.E. Warren AFB include the construction of storm sewers, open channels, berms, detention facilities and outfall structures. The primary purpose of the proposed action is to enhance the mission effectiveness of F.E. Warren AFB while improving the level of safety for both personnel and property, on- and off-base, during major storm events. Above and below ground structures constructed and/or altered as part of the proposed action will detain, divide and convey stormwater flows in a fashion that prevents dangerous flooding of roadways, overtopping of bridges and damage to base facilities, while adequately limiting flows to the city of Cheyenne via Crow Creek. The principal structures constructed or modified as part of the proposed action will provide the additional storage and conveyance that current systems do not effectively provide during major storm events. During a 100-year flood event, the proposed action will allow the base to reduce discharge at Randall Avenue by approximately 84%, meter discharge into Crow Creek to ensure that the base is not adding to the critical flow handled by the city and eliminate flows from the northern part of the base into historic facilities.

#### **FINDING OF NO SIGNIFICANT IMPACT**

The EA was prepared and evaluated pursuant to the National Environmental Policy Act (Public Law 91-190, 42 U.S.C. 4321 *et seq*) and the Air Force Environmental Impact Analysis Process (32 CFR 989). I have concluded that the Proposed Action does not constitute a "major federal action significantly affecting the quality of the human environment" when considered individually or cumulatively in the context of the referenced act, including both direct and indirect impacts. Therefore, an Environmental Impact Statement is not necessary.

#### **RATIONALE FOR DECISION**

My decision to approve the Proposed Action, constructing improvements to the existing stormwater system on F.E. Warren AFB, is based upon the following:

- The project will alleviate dangerous flooding on the installation and in the city of Cheyenne, such as the flood that occurred on 1 August 1985, which resulted in 12 deaths and over \$60 million in damages

Report Documentation Page				Form Approved OMB No. 0704-0188	
Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.					
1. REPORT DATE <b>MAY 2005</b>		2. REPORT TYPE		3. DATES COVERED <b>00-00-2005 to 00-00-2005</b>	
4. TITLE AND SUBTITLE <b>Final Environmental Assessment for Stormwater Drainage Project on F. E. Warren Air Force Base, Wyoming</b>				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) <b>90th Civil Engineer Squadron (90 CES/CEVP),300 Vesle Dr Ste 600,Francis E. Warren AFB,WY,82005</b>				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT <b>Approved for public release; distribution unlimited</b>					
13. SUPPLEMENTARY NOTES					
14. ABSTRACT					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT <b>Same as Report (SAR)</b>	18. NUMBER OF PAGES <b>56</b>	19a. NAME OF RESPONSIBLE PERSON
a. REPORT <b>unclassified</b>	b. ABSTRACT <b>unclassified</b>	c. THIS PAGE <b>unclassified</b>			

Overall, the negative impacts on natural resources, such as vegetation and wildlife, will be short-term

Water lost through evaporation from the detention basins has been determined to be insignificant, and no depletions to the Platte River system will occur as a result of detaining water for up to 24 hours during a 100-year storm event

The construction of outfalls to Crow Creek will not significantly adversely impact the Colorado butterfly plant or the Preble's meadow jumping mouse

The design shall ensure that historic landscapes and architectural features are maintained, as well as views from the Historic District

The Camp Carlin cultural site will be tested and, if necessary, excavated to preserve any artifacts that may be present in the vicinity of the proposed action

Aggressive weed management will be implemented to ensure no adverse effects from the spread of noxious weeds will result from construction of the proposed action

Disturbed areas will be monitored and managed for two years following completion of the project

Outfall structures in the floodplain will be constructed of buried boulders with vegetation planted in between in order to facilitate movement of the Preble's meadow jumping mouse

Construction workers will be educated on the importance of conserving threatened and endangered species and the identifying features of Colorado butterfly plant

Populations of Colorado butterfly plant near the proposed construction sites will be fenced to avoid accidental disturbance of the plant

Should Colorado butterfly plant be detected where it cannot be avoided, construction activities will be halted immediately and the U.S. Fish and Wildlife Service will be contacted to discuss options for proceeding

- An erosion and sedimentation control plan will be implemented to avoid soil erosion and channelization effects to Crow Creek
- A Spill Control Plan, which includes the procedures, instructions and reports to be used in the event of an unforeseen spill of a regulated substance, will be required from the construction contractor
- The base will obtain authorization from the U.S. Army Corps of Engineers prior to commencing with any activities that include discharges of dredged or fill material into waters of the United States


Based on the analysis in the EA, the impacts to wildlife and other resources resulting from the proposed project, independently or cumulatively, will not be significant. The project will have a long-term positive impact on the health and safety of the base and the surrounding community.

#### FINDING OF NO PRACTICABLE ALTERNATIVE

In order to provide adequate drainage for the base, storm flows must be channeled into Crow Creek, which is the primary drainage for the base and the city of Cheyenne. Thus, constructing outfalls in the floodplain is necessary and construction in or near base wetlands is unavoidable. The proposed action shall include all practicable measures to minimize harm.

- Best Management Practices (BMPs) will be required for all construction activities, including erosion and stormwater runoff control
- The impact to or destruction of existing wetlands or wetland vegetation will be minimized

Pursuant to Executive Orders 11990 and 11988, the authority delegated by SAFO 780-1 and 32 CFR Part 989, and taking the information contained in the attached EA into consideration, I find there is no practical alternative to implementing the proposed action in a wetland.



DANIEL P. LEAF  
Lieutenant General, USAF  
Vice Commander

**FINAL**  
**ENVIRONMENTAL ASSESSMENT**  
**FOR**  
**STORMWATER DRAINAGE PROJECT**  
**ON**  
**F. E. WARREN AIR FORCE BASE, WYOMING**

**May 2005**

Prepared by:  
90 CES/CEVP, FRANCIS E. WARREN AFB, WYOMING

## TABLE OF CONTENTS

<b>1.0 PURPOSE OF AND NEED FOR ACTION.....</b>	<b>1</b>
1.1. Assumptions.....	2
1.2. Scope of the Environmental Assessment .....	3
<b>2.0 ALTERNATIVES INCLUDING THE PROPOSED ACTION .....</b>	<b>3</b>
2.1. Alternative 1 (Preferred Alternative) – Construct New Detention Basins, Open Channels, and Rip-Rapped Outfalls .....	3
2.2. Alternative 2 – Elevated Outfalls.....	6
2.3. Alternative 3 – No Action.....	6
2.4. Alternatives Eliminated from Further Consideration .....	7
2.4.1. Basin on Argonne Parade Field .....	7
2.4.2. Basins on Champagne and Vesle Parade Fields.....	7
2.4.3. Basin on F. E. Warren Golf Course .....	7
2.4.4. Utilize Underground Storm Sewer System in Place of Additional Detention Basin .....	7
2.4.5. Utilize Buried Pipelines for Outfalls.....	8
<b>3.0 AFFECTED ENVIRONMENT.....</b>	<b>8</b>
3.1 General Setting .....	8
3.2 Land Use .....	8
3.3 Geology, Soils, and Topography.....	8
3.4 Meteorology.....	9
3.5 Air Quality .....	9
3.6 Water Resources .....	9
3.7 Wetlands .....	10
3.8 Plant Communities.....	11
3.9 Fish and Wildlife .....	11
3.10 Threatened and Endangered Species .....	12
3.11 Noxious Weeds.....	13
3.12 Cultural and Archeological Resources.....	18
3.13 Health and Safety.....	18
3.14 Noise.....	19
3.15 Hazardous Materials, Hazardous Waste, and Solid Waste .....	19
3.16 Utilities .....	20
<b>4.0 ENVIRONMENTAL CONSEQUENCES.....</b>	<b>20</b>
4.1. Past, Present, and Reasonably Foreseeable Projects.....	20
4.1.1. Past Projects .....	20
4.1.2. Present Projects .....	20
4.1.2.1. Freedom Elementary School.....	20
4.1.3. Reasonably Foreseeable Projects .....	21
4.1.3.1. Military Family Housing (MFH) Privatization .....	21
4.1.3.2. Lead-Based Paint Abatement in Historic Military Family Housing Units.....	21
4.1.3.3. Consolidated Fire Department – Renovation and New Construction .....	21
4.2. All Alternatives (Except No Action) .....	21
4.2.1. Land Use.....	21
4.2.2. Air Quality .....	22
4.2.3. Health and Safety .....	22
4.2.4. Noise .....	23
4.2.5. Hazardous Materials, Hazardous Waste, and Solid Waste .....	23
4.2.6. Utilities .....	23
4.2.7. Environmental Justice.....	24
4.2.8. Socioeconomic Conditions .....	24

## *Stormwater Drainage Project, Final Environmental Assessment*

<b>4.3. Alternative 1 (Preferred Alternative) – Construct New Detention Basins, Open Channels, and Rip-Rapped Outfalls .....</b>	<b>24</b>
4.3.1. Geology, Soils, and Topography.....	24
4.3.2. Water Resources .....	25
4.3.3. Wetlands .....	25
4.3.4. Plant Communities.....	26
4.3.5. Fish and Wildlife .....	26
4.3.6. Threatened and Endangered Species.....	26
4.3.7. Noxious Weeds .....	27
4.3.8. Cultural and Archeological Resources.....	28
<b>4.4. Alternative 2 – Elevated Outfalls.....</b>	<b>29</b>
4.4.1. Geology, Soils, and Topography.....	29
4.4.2. Water Resources .....	29
4.4.3. Wetlands .....	29
4.4.4. Plant Communities.....	30
4.4.5. Fish and Wildlife .....	30
4.4.6. Threatened and Endangered Species.....	30
4.4.7. Noxious Weeds .....	31
4.4.8. Cultural and Archeological Resources.....	31
<b>4.5. Alternative 3 – No Action.....</b>	<b>31</b>
4.5.1. Land Use.....	31
4.5.2. Geology, Soils, and Topography.....	31
4.5.3. Air Quality .....	32
4.5.4. Water Resources .....	32
4.5.5. Wetlands .....	32
4.5.6. Plant Communities.....	32
4.5.7. Fish and Wildlife .....	32
4.5.8. Threatened and Endangered Species.....	33
4.5.9. Noxious Weeds .....	33
4.5.10. Cultural and Archeological Resources.....	33
4.5.11. Health and Safety .....	33
4.5.12. Noise .....	34
4.5.13. Hazardous Materials, Hazardous Waste, and Solid Waste.....	34
4.5.14. Utilities.....	34
4.5.15. Environmental Justice .....	34
4.5.16. Socioeconomic Conditions.....	35
<b>5.0 LIST OF PREPARERS .....</b>	<b>36</b>
<b>6.0 LIST OF AGENCIES, ORGANIZATIONS, AND PERSONS TO WHOM COPIES OF THE STATEMENT ARE SENT .....</b>	<b>37</b>
<b>7.0 REFERENCES .....</b>	<b>38</b>

### **APPENDIX A: MAPS AND FIGURES**

Figure A.1 Flood of 1985
Figure A.2 Example of Dry Detention Basin
Figure A.3 Examples of Berms
Figure A.4 Examples of Open Channels
Figure A.5 Examples of Rip-Rap
Figure A.6 Stormwater Project Map
Figure A.7 Wetlands Near Outfall 1
Figure A.8 Wetlands Near Outfall 2A
Figure A.9 Wetlands Near Outfall 4
Figure A.10 Colorado Butterfly Habitat on F. E. Warren AFB

## *Stormwater Drainage Project, Final Environmental Assessment*

Figure A.11 Colorado Butterfly Plant Populations Near Outfall 1  
Figure A.12 Preble's Habitat on F. E. Warren AFB  
Figure A.13 Preble's Captures on F. E. Warren AFB, 1995 to Present  
Figure A.14 Canada Thistle Near Outfall 1  
Figure A.15 Canada Thistle Near Outfall 2A  
Figure A.16 Canada Thistle Near Outfall 4  
Figure A.17 Leafy Spurge Near Outfall 1  
Figure A.18 Leafy Spurge Near Outfall 2A  
Figure A.19 Leafy Spurge Near Outfall 4  
Figure A.20 Dalmatian Toadflax Near Outfall 1  
Figure A.21 Dalmatian Toadflax Near Outfall 2A  
Figure A.22 Dalmatian Toadflax Near Outfall 4  
Figure A.23 Hound's Tongue Near Outfall 1  
Figure A.24 Hound's Tongue Near Outfall 2A  
Figure A.25 Hounds Tongue Near Outfall 4  
Figure A.26 Areas of Unexploded Ordnance on F. E. Warren AFB  
Figure A.27 Plumes of Trichloroethene (TCE) on F. E. Warren AFB  
Figure A.28 Landfills on F. E. Warren AFB  
Figure A.29 Quantity-Distance (Q-D) Arcs

### **APPENDIX B: TERMS AND DEFINITIONS**

### **APPENDIX C: USFWS CORRESPONDENCE**

### **APPENDIX D: SHPO CORRESPONDENCE**

### **APPENDIX E: PUBLIC AND AGENCY COMMENTS**

### **APPENDIX F: RESPONSE TO COMMENTS**



## 1.0 PURPOSE OF AND NEED FOR ACTION

Intense storms and large floods are natural events for the Cheyenne area. The most devastating flood on record occurred on 1 August 1985 ([Appendix A, Figure 1](#)) taking 12 lives and causing over \$60 million in property damage. The inadequacy of the local drainage system was obvious during the 1985 flood, and much of this inadequacy remains today (City of Cheyenne 2005). Francis E. Warren Air Force Base (F. E. Warren AFB) has experienced flooding many times in the past. It is estimated that in the past century, the local area has experienced five major storm events. F. E. Warren AFB is located upstream from the city of Cheyenne and, via the current drainage patterns, water accumulates on base and is funneled through the main gate along Randall Avenue into the downtown Historic District of Cheyenne. During a major storm event, over 1,100 cubic feet per second (cfs) of stormwater can be channeled into the city. During the 1985 flood, the flow downtown where the damage was most severe reached 2,000 cfs; therefore, the flow contribution from base drainage is significant (Balloffet-Entranco 2001).

Floods are classified according to their frequency and depth. For instance, there are 10-year, 25-year, 50-year, 100-year, and 500-year floods. A 100-year flood occurs less frequently than a 10-year flood, but because a 100-year flood carries more volume and depth of water, it is far more destructive and presents a more serious threat to human safety (CCRFGD 2005). A 100-year flood has a 1% chance of occurring in any given year.

A major component of the proposed action is the construction of detention basins. Detention basins are stormwater basins that are designed to intercept a volume of stormwater runoff and temporarily impound the water for gradual release to a receiving stream or storm sewer system. Detention basins are designed to completely empty out between runoff events and are primarily used to reduce the peak discharge of stormwater to receiving streams to limit downstream flooding and to provide some degree of channel protection. Detention basins can limit downstream scour and loss of aquatic habitat by reducing peak flow rate and energy of stormwater discharges to the receiving stream. Typically, detention basins are designed so that release rates are comparable to pre-development flow rates (Metropolitan Council 2005). The rate at which stormwater drains out of a detention basin is influenced by several factors, one of which is the stormwater level in the receiving channel. Typically, as stormwater levels recede in the receiving channel, stormwater will drain out of the detention basin accordingly (Harris County 2005).

F. E. Warren AFB has a topography and drainage pattern that collects stormwater over a large area and channels it through the base into the City of Cheyenne. The current stormwater drainage system is undersized and ineffective in controlling the flow of stormwater, and is not reliable or safe for either minor or major storm events (USAF 2004a). The modification of the current stormwater drainage system on F. E. Warren AFB is necessary to minimize the current threat to life and property both on base and in the greater Cheyenne area during major storm events.

Storm drainage structures have been installed on base at various times over the past 50 years. These systems include drainage culverts, underground storm drainage systems, roadside ditches, curbs, and gutters. Unfortunately, most underground systems are undersized according to current standards. Also, many are silted-in and are either partially or completely ineffective. The existing system cannot handle a 10-year design storm, a minor event, and a 100-year design storm cannot be controlled by existing structures.

While the most direct considerations are the immediate dangers to life and property caused by such floods, mission effectiveness on base can also be affected. There are three bridges that connect the north section of the base to the mission-oriented south section. Overtopping of the bridges that connect these sections disrupts mission effectiveness and can impede the ability of missile crews to reach field sites. In

addition, the F. E. Warren AFB Historic District (Historic District) has been designated a National Historic Landmark and contains approximately 220 brick structures, most of which are now in use as Military Family Housing for officer's and their families. These historic structures are located in an area of the base that is particularly susceptible to flood damage.

The primary purpose of the proposed action is to enhance the mission effectiveness of F. E. Warren AFB while improving the level of safety for both personnel and property, on and off base, during major storm events. Above and below ground structures constructed and/or altered as part of the proposed action will detain, divide, and convey stormwater flows in a fashion that prevents dangerous flooding of roadways, overtopping of bridges, and damage to base facilities, while adequately limiting flows to the City of Cheyenne via Crow Creek. The proposed action will also provide improvements that increase conveyance of runoff during minor storm events to reduce associated local flooding and ponding. The principal structures constructed or modified as part of the proposed action will provide the additional storage and conveyance that current systems do not effectively provide during major storm events. The proposed improvements will focus on a primarily aboveground approach in pursuing these two objectives. During a 100-year flood event, the proposed action will allow the base to reduce discharge at Randall Avenue by approximately 84%, meter discharge into Crow Creek to ensure that the base is not adding to the critical flow handled by the city, and eliminate flows from the northern part of the base into historic facilities (USAF 2001).

## **1.1. ASSUMPTIONS**

The proposed action and/or alternatives, if approved, will be implemented via a Design-Build contract. Design-Build is a method of project delivery in which one entity (design-builder) forges a single contract with the owner (in this case, F. E. Warren AFB) to provide for architectural/engineering design services and construction services. By contrast, with the traditional "design-bid-build" approach, the owner commissions an architect or engineer to prepare drawings and specifications under a design contract, and subsequently selects a construction contractor by competitive bidding (or negotiation) to build the facility under a construction contract (DBIA 2005). With the traditional "design-bid-build" approach, it is possible to use the project design to more accurately analyze the potential environmental impacts of the project without committing resources toward the actual construction of the project. In the case of Design-Build, the analysis of the potential environmental impacts must be completed prior to entering into the Design-Build contract because there is no delay between design and construction.

Without a design to refer to, the potential environmental impacts must be based on assumptions. The base completed an investigative study for the proposed action in 2001, and the following assumptions are based on the information contained in the study. If the subsequent design is significantly different than the information presented in this EA, a supplemental EA will have to be completed prior to beginning construction activities.

**Basins** – It is assumed that the basins will be excavated to a depth adequate for detaining the volume of water produced by a 100-year storm event. It is also assumed that the basins will remain dry between storm events ([Appendix A, Figure 2](#)). Some of the basins will be constructed in series, with one basin collecting water before sending it to the next basin, until the water is ultimately discharged to Crow Creek. Other basins will operate independently of other basins. The investigative study indicates that Basin A, for the most part, is a natural basin and will require little excavation. The remaining basins do not appear to be natural basins and will require substantial excavation.

**Detention Time** – It is assumed that the basins will detain water for up to 24 hours after a 100-year storm event. Based on this 24-hour timeframe, and discussions with the U.S. Fish and Wildlife Service,

evaporation rates have been determined to be insignificant, and no depletions to the Platte River system will occur.

**Berms** – It is assumed that the berms will be constructed with soil excavated from the basins. Examples of berms are shown in [Appendix A, Figure 3](#).

**Open Channels** – It is assumed that the open channels will be grass-lined, rather than concrete-lined ([Appendix A, Figure 4](#)). It is also assumed that at least some of the open channels will utilize rip-rap (large stones placed on soil surfaces or stream beds to reduce erosion by flowing water) ([Appendix A, Figure 5](#)).

**Outfalls** – It is assumed that the outfalls to Crow Creek will incorporate recommendations provided by the U.S. Fish and Wildlife Service (USFWS) ([Appendix C](#)). These recommendations include:

- Avoiding the development of concrete-lined outflows into Crow Creek
- Utilizing large buried boulders (rip-rap) at the outflows and revegetating with native grasses, forbs, shrubs and willows
- Including a monitoring component to ensure that revegetation is successful
- Utilizing vegetation that mimics the habitat types that were present prior to ground disturbance
- Applying aggressive weed management to assist in the establishment of planted vegetation

## **1.2. SCOPE OF THE ENVIRONMENTAL ASSESSMENT**

This Environmental Assessment (EA) is required by the Air Force Environmental Impact Analysis Process (32 CFR 989), the National Environmental Policy Act (Public Law 91-190), and Council on Environmental Quality (CEQ) Regulations (40 CFR Parts 1500-1508). This EA identifies, describes, and evaluates the potential direct, indirect, and cumulative environmental impacts that could result from the proposed actions. This EA also identifies mitigation and/or management measures to prevent or minimize environmental impacts.

## **2.0 ALTERNATIVES INCLUDING THE PROPOSED ACTION**

### **2.1. ALTERNATIVE 1 (PREFERRED ALTERNATIVE) – CONSTRUCT NEW DETENTION BASINS, OPEN CHANNELS, AND RIP-RAPPED OUTFALLS**

The proposed action will be located within the boundaries of F. E. Warren AFB. Locations for the components of the proposed action have been sited based on: 1) principles intended to optimize and augment existing conditions; 2) site improvements based on necessity due to known stormwater impacts; and 3) avoiding adverse effects on the Historic District. Proposed improvements include the construction of storm sewers, open channels, berms, detention facilities, and outfall structures. Total work will include construction of approximately 9,178 feet of underground storm sewer, approximately 860,010 cubic yards of channels and detention basins, and approximately 1,000 feet of drainage culverts. Refer to [Appendix A, Figure 6](#) for an illustrated version of the following descriptions.

#### **Proposed Improvements to Existing Storm Sewers, Open Channels, Berms, and Detention Facilities**

Existing Storm Sewers: The base has existing storm sewer systems that will require augmentation and improvement. Additional inlets will be required along Randall Avenue to allow a greater amount of stormwater into the system. The existing systems will need to be cleaned out to ensure proper

conveyance and discharge. The existing system will also be incorporated into proposed aboveground improvements.

Existing Open Channels: Existing open channel systems will be incorporated into the design. Many of these exist to the south of Crow Creek; however, several key channels are situated in the northern portion of the base. An existing open channel, south of the base's main gate between I-25 and South Fort Steele Way, will be a key feature in conveying stormwater from the north and west. This channel will connect the storm drainage outfall in the northern developed areas of the base to Basin I south of the railroad tracks. To ensure maximum efficiency, this channel will be accompanied by berms. Improvements to these, and other similar open channels, may include alteration to width or depth, or rerouting to improve functionality. Open channels may also be used to better utilize natural flow patterns. In addition, existing culverts aid natural drainage flow. While the majority of these culverts will remain in their current locations, some of them will need to be removed, particularly along the west end of Central Avenue, to aid in rerouting storm flows to prescribed outfalls.

Existing Berms: The major sites of existing berms are north of Atlas housing (along Wapiti Road) and southeast of the basin near the base clinic (Building 160). Although improvements are not planned for the Wapiti Road berm, its function will be better utilized with the planned drainage route.

Existing Detention Facilities: Primary existing detention consists of the Pearson Reservoirs (base lakes), Lake Centennial, Basin F, Basin I, and the drainage basin near the base clinic. Basin I will require significant improvement to accommodate additional flows that, under the proposed action, will be diverted in this direction. The basin near the clinic may also require improvement to increase its effectiveness in conjunction with the proposed action. The modification of existing basins will primarily be an earthwork effort to build berms and to deepen and widen existing basins. This will also involve construction of concrete outfall structures on each basin.

### **Proposed Construction of Storm Sewers, Open Channels, Berms, Detention Facilities, and Outfalls**

Several thousand feet of storm sewers and open channels are proposed that will connect the drainage basins and ultimately lead stormwater flows to Crow Creek. Open channels that are constructed in visible areas will have very shallow side slopes (typically with an aspect ratio of 5:1) so that the presence of a storm conveyance is not readily visible.

Proposed Storm Sewers: Improvements and additions to existing underground storm sewer systems will be required. The proposed action attempts to limit construction of new underground storm sewer systems, however some may be required to meet project objectives. Below grade conveyances may be the only suitable alternative in the vicinity of Lake Centennial, as flows detained in and routed through this area will need to be conveyed under Randall Avenue.

Proposed Open Channels: New open channels are necessary to convey stormwater from detention facilities to their prescribed outfalls into Crow Creek. Culverts at road and railroad crossings will be required for these open channels to maintain desired flow patterns and avoid unwanted stormwater accumulations.

Proposed Berms: Berms are proposed along the edges of all the new basins. Berming will also be required for the open channel south of Randall Avenue to carry stormwater south of the BNSF Railroad.

Proposed Detention Facilities and Outfalls: The proposed drainage basins will be designed to catch stormwater coming from the north and west, and detain it long enough to permit safe transfer through

the base to Crow Creek. They will also help to divide oncoming stormwater such that it can be transferred in quantities small enough to be handled by smaller, less expensive sewer pipes and aboveground conveyances. New detention facilities will attempt to utilize natural flow patterns and contours where they are advantageous.

The following discussions describe the proposed detention basins and outfalls.

Western Portion of Base – Detention Basins A, B, and C, and Outfall 1

The principle functions of Basins A, B, and C are the collection and diversion of the bulk of off-site runoff from the north and west. The associated outlet structure will convey the stormwater to Crow Creek before it enters the central base area. It is estimated that these basins will divert 1,079 cfs of water for a 100-year storm event and will ensure that these runoff flows will have no impact on the developed portions of the base, to include the Historic District. Stormwater collected in Basins A, B, and C will drain from each basin through a system of culverts and open channels until the water reaches Outfall 1, where it will flow into Crow Creek. Outfall 1 is proposed to be a rip-rapped channel with vegetation planted between the boulders to impede and slow stormwater flow as it is diverted into Crow Creek.

At Outfall 1, the existing water surface elevation (WSEL) for Crow Creek is 6,134.36 feet. With the detention basins in place, the WSEL would be 6,134.04 feet. The reason the WSEL is less for the proposed action over that of the existing condition is due to the fact that an adjacent drainage basin located west of the base is purposely routed to Outfall 1. This represents a worst-case condition that Outfall 1 must be designed to accommodate. For the existing condition, Crow Creek accepts this discharge upstream of the base, which increases the WSEL in Crow Creek upstream of Outfall 1. New berms and open channels will be constructed to help channel storm flows from these drainage basins to Outfall 1.

Central Portion of Base – Outfall 2A

Outfall 2A will be constructed going south and following Vesle Drive. Outfall 2A has an existing WSEL of 6,106.90 feet. The proposed action produces a WSEL of 6,106.90 feet. Outfall 2A is proposed to be a rip-rapped channel with vegetation planted between the boulders to impede and slow stormwater flow as it is diverted into Crow Creek.

Eastern Portion of Base – Detention Basin H and Outfall 4

The addition of Basin H west of Lake Centennial is the most cost-effective means of capturing storm flows from the north and west. Basin H will collect the flows diverted by the existing Basin F and associated grass-lined channel north of the Historic Officer's Quarters. Construction of Basin H will require construction of berms surrounding the basin, as well as construction of an open channel to divert flow to Basin I, and ultimately to the proposed Outfall 4 at Crow Creek. This portion of the proposed action would also require construction of an underground storm sewer system and associated culverts to convey flow underneath Randall Avenue.

Stormwater collected in Basin H will drain into a storm sewer system before being deposited into an open channel south of Gate 1. The open channel will carry stormwater south and underneath the BNSF Railroad tracks to Basin I, where the water will be released into Crow Creek at Outfall 4.

Outfall 4 is proposed south of Missile Drive on the eastern side of the base, near I-25. Outfall 4 has an existing WSEL of 6,079.07 feet. The proposed action produces a WSEL of 6,079.22 feet. The

WSEL is 0.15 feet higher for the proposed action than the present condition due to the added discharge into Crow Creek at this outfall. Outfall 4 is proposed to be a rip-rapped channel with vegetation planted between the boulders to impede and slow stormwater flow as it is diverted into Crow Creek.

With regard to threatened species habitat in the vicinity of the outfalls to Crow Creek, the base will do the following:

**Colorado butterfly plant:**

- 1) Coordinate with the Wyoming Natural Diversity Database (WYNDD) to determine exact locations of Colorado butterfly plant and monitor effects of the project;
- 2) Work with the WYNDD on efforts to transplant Colorado butterfly plants that may otherwise be unavoidably destroyed by ground disturbance;
- 3) Develop a weed control program to include managing weeds prior to ground disturbance in areas much larger than the actual footprint of the project and monitoring control efforts for several years after completion of the project;
- 4) Educate contractors on what the plant looks like and the importance of avoiding it;
- 5) Use mats to avoid destruction of vegetation if heavy equipment must move through wetlands or riparian areas. In order to avoid destroying Colorado butterfly plant, heavy equipment should be used prior to bolting of the plant in June.

**Preble's meadow jumping mouse:**

- 1) Avoid the development of concrete-lined outflows into Crow Creek;
- 2) Rip-rap outflows with large buried boulders, and revegetate with native grasses, forbs, shrubs, and willows;
- 3) Include a monitoring program to ensure that revegetation is successful;
- 4) Utilize vegetation that mimics the habitat types that were present prior to ground disturbance;
- 5) Implement an aggressive weed management program to assist with establishment of native vegetation.

## **2.2. ALTERNATIVE 2 – ELEVATED OUTFALLS**

Alternative 2 is to utilize elevated pipelines at each outfall, rather than rip-rapped channels, in addition to the remainder of the components of the proposed action (e.g., basins, open channels, etc.). Elevated pipelines would facilitate movement of the Preble's meadow jumping mouse throughout the Crow Creek corridor, and to minimize disturbance of Colorado butterfly plant habitat on the west end of Crow Creek.

## **2.3. ALTERNATIVE 3 – NO ACTION**

Alternative 3 is to take no action; no construction or modifications will be made to the existing stormwater drainage system. This alternative does not address the hazards associated with flooding and does not meet the need specified in Section 1.0.

## **2.4. ALTERNATIVES ELIMINATED FROM FURTHER CONSIDERATION**

### **2.4.1. Basin on Argonne Parade Field**

This alternative would divert water directly through the historic Argonne Parade Field. A portion of the parade field would be utilized as a large, shallow detention basin. This alternative would provide a direct route for stormwater and would reduce the amount of flow on Randall Avenue. It would also require a below ground conveyance and associated structures to divert flow southeast of the Historic District, under Randall Avenue, to Basin I. This basin would utilize an existing storm drain as an outfall, and would discharge into Crow Creek immediately downstream of the Old Glory Road crossing.

Development of the Argonne Parade Field is strongly discouraged due to the historic parade ground activity, the significance of the open space as the foreground to the Historic Officer's Quarters and the potential for historic artifacts underground in this area. In a letter dated 13 December 2000 ([Appendix D](#)), the Wyoming State Historic Preservation Office (SHPO) provided the following input:

“As we discussed at our meeting on December 6 [2000], the introduction of drainage ponds on the parade ground would be an “Adverse Effect” to this significant cultural landscape. This decision is arrived at through information provided in “The Secretary of the Interior’s Standards for the Treatment of Historic Properties with Guidelines for the Treatment of Cultural Landscapes,” and the knowledge of the role of the parade ground in a military garrison. In essence, it was the one location in which all military personnel were assembled oblivious to rank. Activities ranging from morning formations, parade functions, change of command, drilling and other activities associated with garrison living were performed by the entire command. Its significance is as great as any other singular or collective component within the National Historic Landmark Boundaries.”

Based on the strong opposition of the SHPO, this alternative was eliminated from further discussion.

### **2.4.2. Basins on Champagne and Vesle Parade Fields**

Although arguably not as significant as Argonne Parade Field, these smaller parade fields are also included within the boundaries of the National Historic Landmark. Due to the stance taken by the SHPO, and with other land available for basins, it was decided that these locations would not be pursued.

### **2.4.3. Basin on F. E. Warren AFB Golf Course**

This alternative would divert water from the Pearson Reservoirs through the base golf course, where it would flow into the open channel behind the Historic Officer's Quarters and into to Basin H. Due to issues with funding regulations (appropriated funds versus non-appropriated funds), this alternative was eliminated in order to avoid the appearance of misappropriation of funds.

### **2.4.4. Utilize Underground Storm Sewer System in Place of Additional Detention Basin**

This alternative would utilize an underground storm sewer system to carry stormwater south along Rogers Road and Vesle Drive before going underneath the BNSF Railroad and outletting to Crow Creek. This alternative is estimated to be the most expensive and difficult to construct. In addition, because it would not incorporate additional detention, it would have the greatest impact on Crow Creek and would require further efforts to preserve wetlands and lessen the impact downstream. Therefore, this alternative was eliminated from further discussion.

#### **2.4.5. Utilize Buried Pipelines for Outflows**

It is believed that buried pipelines near Crow Creek would not be able to maintain proper flow due to the relatively flat terrain in the floodplains. Therefore, this alternative was eliminated from further discussion.

### **3.0 AFFECTED ENVIRONMENT**

#### **3.1. GENERAL SETTING**

F. E. Warren AFB is located in the southeastern corner of Wyoming on the western edge of the City of Cheyenne, in Laramie County. It is approximately 11 miles north of the Colorado-Wyoming border, 100 miles north of Denver, Colorado, and 45 miles west of the Nebraska-Wyoming border.

The base encompasses 5,866 acres and is oriented in a general north-south direction. The base is bounded on the east by I-25, which separates the base from high-density residential areas of Cheyenne. The base is bounded on the west by Roundtop Road, low-density residential development, and the U.S. Department of Agriculture's High Plains Grassland Research Station. The base is bounded on the north by generally open rangeland, and on the south by State Highway 210, low-density residential development, and open rangeland.

F. E. Warren AFB is the second-largest employer in the area. The base currently employs 956 civilians and 3,764 military personnel, with payroll and expenditures infusing over \$304 million into the local economy in fiscal year 2004 (USAF 2005). The only foreseeable change in installation population will result from the Peacekeeper deactivation, which began in 2002 and will continue until 2006. The deactivation will result in a decrease of approximately 500 active duty military personnel by 2008.

#### **3.2. LAND USE**

The general existing land use patterns at F. E. Warren AFB were established during the installation's development and use as an Army post throughout the early 1900s. Existing land use patterns continue to follow patterns established by the base more than a century ago. Additional facility development and supporting infrastructure have evolved over time as missions and requirements have changes or expanded. The base is divided into three general land use planning sub-areas, each with its own distinct character and function. These sub-areas are: 1) the Historic District/Landmark Area, 2) the Area South of Crow Creek, and 3) the Area North of the Historic District. The Historic District/Landmark Area is heavily developed and contains over 200 historic buildings. The area south of Crow Creek consists of large tracts of open space, an industrial/mission complex, accompanied and unaccompanied housing areas, and a shopping center. The area north of the Historic District is dominated by large open spaces along with outdoor recreation, accompanied housing, industrial, and mission facilities.

#### **3.3. GEOLOGY, SOILS, AND TOPOGRAPHY**

F. E. Warren AFB lies within the High Plains section of the Great Plains Physiographic Province. Rocks within the region range in age from Pre-Cambrian to recent, and are composed primarily of shale with small amounts of sandstone, siltstone, and limestone. The base is in Seismic Zone 1, which means there is a minor seismic event probability.

The predominant soil series on the base is classified texturally as loamy, with an average topsoil depth ranging from four to six inches. The subsoil is primarily alluvial clay that extends from a depth of



approximately 6 to 36 inches. Refer to the U. S. Department of Agriculture, Soil Conservation Service, *F. E. Warren Air Force Base Soil Report* (1992), for additional detail.

Base topography is characterized by broad plateaus that are nearly flat in the historic core, and increase in slope along the ridgelines and along Crow Creek. Elevation ranges from 6,080 feet in the southeastern portion of the base, to 6,365 feet in the northern portion. Most areas with slopes of 10 percent or greater, which are generally considered unsuitable for construction, are located in the undeveloped northern third of the base.

### **3.4. METEOROLOGY**

F. E. Warren AFB experiences moderately warm summers and cold winters. The average annual temperature is 46° Fahrenheit (F). The average daily maximum and minimum temperatures are 83° F in July and 26° F in January. Temperature extremes range from -34° to 100° F. Prevailing winds are from the northwest to west throughout the year, with secondary peaks in wind frequency from the south to north, spring through autumn. The annual average wind speed is 13.7 miles per hour. Annual average precipitation is about 14 inches. Winter is the driest season, with average monthly precipitation of less than one inch. Late spring and early summer are the wettest times of the year, with just over two inches average monthly precipitation (USAF, 2004a).

### **3.5. AIR QUALITY**

Under provisions of the Clean Air Act, which is intended to improve the quality of the air we breathe, the Environmental Protection Agency (EPA) sets limits on how much of a pollutant can be in the air anywhere in the United States. This ensures that all Americans have the same basic health and environmental protections. The law allows individual states to have stronger pollution controls, but states are not allowed to have weaker pollution controls than those set for the whole country. EPA calls these pollutants "criteria air pollutants" because the agency has regulated them by first developing health-based criteria (science-based guidelines) as the basis for setting permissible levels. One set of limits (primary standard) protects health; another set of limits (secondary standard) is intended to prevent environmental and property damage. A geographic area that meets or does better than the primary standard is called an **attainment area**; areas that don't meet the primary standard are called **non-attainment areas**. Laramie County is designated as an attainment area for all criteria air pollutants.

### **3.6. WATER RESOURCES**

The installation is located within the Crow Creek Watershed, which is part of the South Platte River Basin. Perennial surface water resources located on the base include Crow Creek, Diamond Creek, North and South Pearson Lakes, and Lake Centennial.

The major drainage of the base is Crow Creek, a perennial stream that flows from northwest to southeast across the southern half of the base. Diamond Creek, a perennial tributary of Crow Creek, flows from southwest to northeast across the southwest portion of the base. An unnamed ephemeral tributary of Crow Creek roughly parallels Diamond Creek flowing from southwest to northeast across the south-central portion of the base.

North and South Pearson Lakes consist of two reservoirs connected by a culvert. Surface water area for North Pearson Reservoir is estimated at 12.6 acres, while South Pearson Reservoir is estimated to at 10.6 acres (Smith Environmental 2004). Lake Centennial reservoir was constructed in 1988 as a flood control basin to hold runoff from the City of Cheyenne, and is estimated at 4.4 acres of surface water.

Currently, stormwater runoff from the base is discharged into Diamond and Crow Creeks pursuant to a permit issued by the Wyoming Department of Environmental Quality (WDEQ). The base lies within two drainage basins. Dry Creek flows to the southeast from the northern section of the base into the City of Cheyenne. Its drainage area covers approximately 7.5 square miles. Crow Creek drains a 300 square mile area, which is over 30 miles long. Crow Creek creates a natural divide between the north and south sections of the base, with both sections generally draining toward Crow Creek. Flood flows along this creek may result from: 1) intense thunderstorms covering a localized area of the base, 2) longer, more moderate storms causing all parts of the basin to contribute runoff, or 3) snowmelt enhanced by rainfall in the springtime months (USAF 2004a).

Depth to groundwater on the installation is variable but generally exceeds 5 feet.

### **3.7. WETLANDS**

Wetlands comprise approximately 64.7 acres of F. E. Warren AFB (approximately 62.3 acres of which are jurisdictional) ([Appendix A, Figures 7, 8, and 9](#)). There are four types of wetlands on the base: open water, palustrine emergent, palustrine shrub-scrub, and palustrine forested wetlands. Most wetlands on the base are associated with riparian areas and the Pearson Reservoirs. Jurisdictional Waters of the U.S. and Wetlands are under the regulatory authority of the U.S. Army Corps of Engineers (USACE). Before initiating any project that will fill or dredge jurisdictional Waters of the U.S. or a wetland area, a Section 404 (Clean Water Act) permit may be required from the USACE.

#### Palustrine Emergent Wetland Habitat Type

The Palustrine Emergent wetland habitat type is observed in and adjacent to drainages on the base. The term “Palustrine” (P) refers to a wetland system that includes all non-tidal (inland) wetlands dominated by trees, shrubs, persistent emergent plant species, and/or emergent mosses and lichens. The term “Emergent” (EM) refers to a class in which a site is dominated by hydrophytic grass, sedge, rush, and forb (flowering plant) herbaceous plant species. Palustrine Emergent (PEM) wetlands on the base vary widely in their appearance based on plant species composition, underlying soil substrate, and the length of time they are inundated or saturated. Based on field observations, three general water regime modifiers are used to describe these wetlands: A for temporarily flooded, C for seasonally flooded, and H for permanently flooded.

#### Palustrine Scrub-Shrub Wetland Habitat Type

The term “Scrub-Shrub” (SS) refers to a class of the Palustrine system that is dominated by generally hydrophytic shrub species. Crack willow (*Salix fragilis*), sandbar willow (*Salix exigua*), and strapleaf willow (*Salix lingulifolia*) shrubs dominate the Palustrine Scrub-Shrub (PSS) wetland habitat type on the base. Two subclasses of Scrub-Shrub wetland habitat occur on the base and are differentiated by a Broad-Leaved Deciduous (1) or a Needle-Leaved Deciduous (2) designation. Scrub-Shrub areas dominated by crack willow shrubs are designated as Broad-Leaved Deciduous, while areas dominated by sandbar or strapleaf willow are designated as Needle-Leaved Deciduous. Two water regime modifiers, A (temporarily flooded) and C (seasonally flooded) are used to describe these wetlands at specific locations.

#### Palustrine Forested Wetland Habitat Type

The term “Forested” (FO) refers to a class of the Palustrine system that is dominated by facultative (i.e., occurring in wetland areas at least 50% of the time) tree species. The Palustrine Forested (PFO) wetland habitat type is dominated by an overstory of tall crack willow, cottonwood (*Populus deltoides*, P.

*angustifolia*, and *P. x acuminata*), or green ash (*Fraxinus pennsylvanica*) trees with well-developed woody bark. Two subclasses of Forested wetland habitat occur on the base and are differentiated by a Broad-Leaved Deciduous (1) or a Needle-Leaved Deciduous (2) designation. Forested areas dominated by plains cottonwood and green ash are designated as Broad-Leaved Deciduous, while areas dominated by crack willow trees and narrowleaf cottonwood are designated as Needle-Leaved Deciduous.

### 3.8. PLANT COMMUNITIES

Three primary vegetation communities occur on the Base: (1) shortgrass prairie grassland; (2) wet (mesic) meadow wetlands; and (3) riparian areas – cottonwood and willow. The shortgrass prairie grassland is dominated by blue grama (*Bouteloua gracilis*), western wheatgrass (*Elymus smithii*), needle-and-thread grass (*Stipa comata*), and fringed sagewort (*Artemisia frigida*). Wet meadows on the base are dominated by foxtail barley (*Hordeum jubatum*), Kentucky bluegrass (*Poa pratensis*), tall wheatgrass (*Elymus elongatus*), baltic rush (*Juncus balticus*), tufted hairgrass (*Deschampsia cespitosa*), bluejoint grass (*Calamagrostis canadensis*), and sedges (*Carex spp.*). The riparian areas are dominated by a shrub scrub community of sandbar willow (*Salix exigua*), strap willow (*Salix lingulifolia*), and crack willow (*Salix fragilis*), with scattered cottonwood (*Populus deltoides*) and green ash (*Fraxinus pennsylvanica*) trees and herbaceous understory similar to the mesic meadows. Much of the previously disturbed and reclaimed areas on the base (e.g., small arms impact area) are dominated by planted crested wheatgrass (*Agropyron cristatum*), which was planted as part of restoration efforts (WEST 2001b). Developed areas of the base have a woody vegetation component that, while not originally present, is extremely important for wildlife, aesthetic, cultural, and social values. Plains cottonwood, Colorado spruce, Ponderosa pine, and green ash are the most important woody vegetation species on the installation. There are no wooded areas of five acres or greater on the base. The urban forest is an intrinsic component of the Historic District; for 16 consecutive years the base has been awarded “Tree City USA” status.

### 3.9. FISH AND WILDLIFE

Fish species collected in Crow Creek during a 2003 study included Central stoneroller (*Camptostoma anomalum*), Goldfish (*Carassius auratus*), Fathead minnow (*Pimephales promelas*), Common shiner (*Luxilus cornutus*), Creek chub (*Semotilus atromaculatus*), Longnose dace (*Rhinichthys cataractae*), White sucker (*Catastomus commersoni*), Longnose sucker (*Catastomus catostomus*), Brook trout (*Salvelinus fontinalis*), Brown trout (*Salmo trutta*), Green sunfish (*Lepomis cyanellus*), Largemouth bass (*Micropterus salmoides*), Johnny darter (*Etheostoma nigrum*), and Iowa darter (*Etheostoma exile*) (Curry 2003).

Several species of trout have been stocked in the Pearson Reservoirs, including brown trout (*Salmo trutta*), rainbow trout (*Salmo gairdneri*), brook trout (*Salvelinus fontinalis*), lake trout (*Salvelinus namaycush*) and Snake River cutthroat trout (*Oncorhynchus clarki*).

Aquatic furbearers on the base include beaver and muskrat. Beavers are found along Crow Creek where woody plant species such as cottonwoods and willow serve as food sources. Muskrats also utilize the aquatic habitats of both Crow and Diamond Creeks, and the Pearson Reservoirs (Rosenlund 1992).

Wildlife on the installation includes pronghorn (*Antilocapra americana*), mule deer (*Odocoileus hemionus hemionus*), white-tailed deer (*Odocoileus virginianus*), badger (*Taxidea taxus*), raccoon (*Procyon lotor hirtus*), porcupine (*Erethizon dorsatum*), red fox (*Vulpes vulpes*), coyote (*Canus latrans*), and Wyoming ground squirrel (*Spermophilus elegans*).

A relatively large herd of pronghorn antelope inhabits the base. Although the pronghorn on the installation are a part of the larger Iron Mountain herd, most reside on the installation year-round. The

base population was approximately 165 animals at the end of 2004. The pronghorn are free ranging and occur throughout the base, including the developed urban areas.

At least 139 species of birds have been recorded on the base. Included among the several species of waterfowl are the tundra swan (*Cygnus columbianus*), Canada goose (*Branta canadensis*), and wood duck (*Aix sponsa*). The birds-of-prey recorded on the base include the turkey vulture (*Cathartes aura*), bald eagle (*Haliaeetus leucocephalus*), peregrine falcon (*Falco peregrinus*), and several species of hawk (*Buteo spp.*) (WEST 2001b).

### **3.10. THREATENED AND ENDANGERED SPECIES**

Two species listed as Threatened under the Endangered Species Act [16 U.S.C 1531 *et seq.*] are present on the installation (WEST 2001a). The Preble's meadow jumping mouse (Preble's) (*Zapus hudsonius preblei*) and the Colorado butterfly plant (*Gaura neomexicana* ssp. *coloradensis*) are known to occur on the installation in the riparian areas ([Appendix A, Figures 10, 11, and 12](#)).

Preble's was listed as Threatened in May 1998. F. E. Warren AFB has designated a buffer zone for Preble's along the entire reach of Crow Creek within the installation's boundaries. Preble's has been documented in Crow Creek on the base during surveys conducted through the University of Wyoming. Preble's specimens were documented in 1995, 1996, 1998, 1999, and 2003. A limited number of captures have taken place near the proposed site of Outfall 1 ([Appendix A, Figure 13](#)). Two specimens were captured during a survey in 1995 west of Crow Creek between Happy Jack Road and Missile Drive. In the 1998 survey, one specimen was captured west of Old Glory Road. All other captures of Preble's have taken place upstream, in the area surrounding the Family Campground.

Preble's are primarily nocturnal; however, individuals have been seen sitting motionless during the day under shrub cover, in nests composed of grass, leaves, and woody material (Schorr 2001). Radio telemetry studies of Preble's in Jefferson County, Colorado, indicate movement both up and down stream channels, as well as perpendicular to the drainage. Mice stay in riparian/wetland areas, and do not travel over cobbles. Preble's spend at least seven months per year in hibernation, in underground burrows that they create themselves. Observed hibernaculae are typically leaf litter nests approximately 30 cm below ground, 9 m above a creek bed under thick shrub cover. Males emerge from hibernation prior to females (late April to early May, and early to late May, respectively). Preble's have been captured on F. E. Warren AFB as late as the second week of September. Based on these dates, the active period for Preble's is roughly May through October, but may be variable from year to year. Most often preferred habitat consists of willow species (*Salix*), but the species composition seems to be secondary to the overall presence of a mature shrub component (USAF 2004c). What seems universally true for Preble's is that a dense, herbaceous ground cover immediately proximate to surface water needs to be present, most often, found in close association with these dense, riparian habitats.

Colorado butterfly plant was listed as Threatened in October 2000, and occurs in the riparian areas of Crow Creek, Diamond Creek, and the Unnamed Drainage on the base ([Appendix A, Figure 10](#)). Colorado butterfly plant is restricted to 23 occurrences over approximately 1,700 acres of habitat (Jennings et al. 1997; Fertig 1998b) in Laramie and Platte counties, Wyoming; western Kimball County, Nebraska; and Weld and Boulder counties in Colorado. The only population on federal land, and the largest known population, is on F. E. Warren AFB. Colorado butterfly plant grows in the wet meadow zone associated with high plains riparian habitat, on mesic soils that occur on a gradient between the saturated soils along streams and the dry soils of surrounding mixed-grass or shortgrass prairie. This subspecies appears to have definite moisture requirements, and may require shallow subsurface water (MOU 1992). The precise effect of changes in groundwater on Colorado butterfly plant populations has yet to be determined. Colorado butterfly plant seedlings require an open habitat for establishment. Plants

are typically not found in areas dominated by woody vegetation such as willow, or in areas of dense vegetation such as occur where noxious weeds invade, except in low numbers or at the margins of such habitat (Fertig 1994, 2000; Heidel 2004).

The installation supports a pre-release conditioning facility for Black-footed ferrets (*Mustela nigripes*), a federally listed endangered species. This fully enclosed facility is operated by the U.S. Fish and Wildlife Service. Ferrets are imported to the facility from captive breeding locations during the summer months, and then removed from the facility several weeks later for transport to release sites in various regions of the United States. There are no other known endangered species on the installation.

The only federally listed aquatic species native to the base is the threatened greenback cutthroat trout. The greenback cutthroat trout is native to the South Platte and Arkansas River drainages, with the majority of greenback cutthroat trout habitat occurring within Colorado. Crow Creek within the base is a tributary of the South Platte River, and within the historic range of the greenback. Although there are no known historic records that document the occurrence of greenbacks within Crow Creek, there are few records on the historic distribution of the species throughout the elevations of the South Platte and Arkansas River drainages (Rosenlund 1992).

Crow Creek is a tributary to the Platte River. Federally-protected species associated with the Platte River system include: whooping crane (*Grus americana*), interior least tern (*Sterna antillarum*), piping plover (*Charadrius melodus*), pallid sturgeon (*Scaphirhynchus albus*), bald eagle (*Haliaeetus leucocephalus*), Eskimo curlew (*Numenius borealis*), and the western prairie fringed orchid (*Platanthera praeclara*).

### **3.11. NOXIOUS WEEDS**

Several noxious weed species are known to occur on F. E. Warren AFB. Noxious weeds are invasive, non-native plants that spread rapidly and cause considerable damage to natural environments. Noxious weeds are defined as those species requiring control in accordance with the Federal Noxious Weed Act. These weeds out-compete native species, often gaining foothold and spreading rapidly in disturbed areas such as construction sites. Of these species, Canada thistle (*Cirsium arvense*), Dalmatian toadflax (*Linaria dalmatica*), Leafy spurge (*Euphorbia esula*), and Common hound's tongue (*Cynoglossum officinale*) are the most prevalent noxious weeds found at F. E. Warren AFB.

These invasive species are of particular concern because of their ability to invade riparian and floodplain areas occupied by rare species such as the Colorado butterfly plant (Jones 1996, Hollingsworth 1996). Expansion of noxious weeds can also potentially affect threatened fauna as well as flora. Past capture localities and the presumed range of Preble's meadow jumping mouse on base overlap with the distribution of large patches of Canada thistle, Leafy spurge, and Dalmatian toadflax. The full effects of noxious weeds on Preble's meadow jumping mouse are poorly understood. Armstrong et al. (1997) suggested that exotic invasive plant species do not appear to prohibit Preble's occupying an area; indeed Preble's have been captured in the center of large Canada thistle stands on F. E. Warren AFB in the recent past (Beauvais 1998). Previous studies in Colorado have suggested that jumping mice are more dependent on the amount of vegetative cover rather than its species composition. Garber (1995) however, suggested that the displacement of the native flora by introduced weeds might be reducing the amount of food available to the jumping mouse population on F. E. Warren AFB. The long-term impact of monocultures of invasive weeds on Preble's population viability remains to be adequately assessed.

Collectively, noxious weeds occupy approximately 180.2 acres (35.5%) of the 508 acres of riparian corridor on the base (Heidel 2002). The two most extensive noxious weeds in the riparian corridor are Canada thistle and Leafy spurge at 108.1 acres and 96.8 acres, respectively. Upper Crow Creek has the most extensive weed invasion for three of the four noxious weed species.

Canada thistle invasion is most severe in upper Crow Creek and upper Unnamed Drainage (32.5% and 35.6%, respectively). Although it is not evenly distributed, it is present throughout the five riparian corridor segments. Leafy spurge is a close second to Canada thistle in its extensiveness, covering 96.8 acres (19.1%) of riparian corridor habitat. It is most severe in upper and lower Crow Creek (20.7% and 30.6%, respectively), and is very unevenly distributed, differing by orders of magnitude with upper Unnamed Drainage (0.02%). Dalmatian toadflax is a close third to Leafy spurge in its extensiveness, covering 88.2 acres (17.4%) of riparian corridor habitat. Like Leafy spurge, it is unevenly distributed between riparian corridor segments and, like most of the noxious weed species, it is most extensive in upper Crow Creek at 31.7 %. Unlike the other noxious weeds, Dalmatian toadflax invasion is widespread in the uplands and dispersal does not appear to be radiating out from the riparian corridor. Common hound's tongue is the least extensive noxious weed in all five riparian segments, ranging from 3.8% in Diamond Creek to 14.4% in upper Crow Creek (Heidel 2002).

### **Canada thistle (*Cirsium arvense*)**

Canada thistle is widely distributed on F. E. Warren AFB and occurs in dense patches along stream drainages. Canada thistle invades natural communities mainly through vegetative reproduction but can also be dispersed long distances by wind blown seed. Seeds can remain viable in soil for up to 21 years and up to four months in water (USGS 2003). It quickly spreads vegetatively via deep rhizomes, and it readily resprouts when cut (Beck 2003). Nearly all parts of the roots can produce buds that gradually develop into shoots and form new plants. One plant can colonize an area three to six feet in diameter in just one or two years. Control of this plant must focus on continual stress of the plant, forcing it to exhaust root nutrient stores and eventually die.

The base began a biological control program in 2004, with Canada thistle being one of the target species. The program is currently focused on controlling weeds in Crow Creek, but is expected to be expanded to other drainages in the coming years.

With respect to the proposed action, Canada thistle is documented in the areas proposed for Outfall 1, Basin H, the open channel near Gate 1, and Outfall 4. Distributions of Canada thistle in the areas of Outfalls 1, 2A, and 4 are shown in [Appendix A, Figures 14, 15, and 16](#). There are several options for both physical and biological control of Canada thistle (USAF 2004d). These options include:

#### Physical Control – Manual/Mechanical Methods

Hand cutting of individual plants or mowing of larger infestations should be conducted prior to seed set and must be repeated until the starch reserves in the roots are exhausted.

#### Physical Control – Prescribed Burning

Early season burning of Canada thistle can stimulate its growth and flowering, therefore controlled burns should be carried out late in the growing season. The extensive root system allows the plant to survive major disturbances and the roots are also able to survive fires of varying severity. New shoots are produced and Canada thistle can colonize recently burned sites that have exposed bare soil.

#### Biological Control – Insects/Pathogens

Red Admiral, viceroys and painted lady butterflies lay eggs on Canada thistle, and the subsequent larvae feed on the leaves and stems. However, only the painted lady butterfly builds up populations high enough to eliminate an infestation.

#### Biological Control – Grazing

Controlled and rotational grazing can prevent establishment. Overgrazing makes area more susceptible to infestation by weakening desirable species.

#### Chemical Control

In natural areas where Canada thistle is interspersed with desirable native plants, targeted application of a systemic herbicide such as glyphosate (e.g., Roundup or Rodeo) is recommended. Glyphosate carries plant toxins to the roots and may be the most effective method for extensive infestations in disturbed areas with little desirable vegetation. Broad, repeated application of this type of herbicide is usually necessary due to the long life of seeds stored in the soil.

#### **Leafy spurge (*Euphorbia esula*)**

Leafy spurge invades natural communities primarily through seed dispersal from mid to late July, into early August. The seed capsules explode, forcibly ejecting seeds up to five meters. The seed can be transported by water and wildlife. Leafy spurge also spreads vegetatively via deep rhizomes and roots (Beck 2003). Roots are woody, tough, and can reach depths up to 15 feet, with a lateral spread of up to 35 feet. Rapid re-establishment of dense stands can occur after apparently successful management because of the long-lived root system (Biesboer 1998). It can re-infest rapidly if left uncontrolled for even a single year. Control of this plant must focus on destruction of the root system. The best management method is to combine controls over four to five years.

The base began a biological control program in 2004, with leafy spurge being one of the target species. The program is currently focused on controlling weeds in Crow Creek, but is expected to be expanded to other drainages in the coming years.

With respect to the proposed action, Leafy spurge is documented in the areas proposed for Outfall 1, Outfall 2A, and Outfall 4 ([Appendix A, Figures 17, 18, and 19](#)). The options for control of leafy spurge (USAF 2004d) include:

#### Physical Control – Manual/Mechanical Methods

Leafy spurge is able to regenerate from small pieces of root so tilling should be used in conjunction with other methods. Tilling can lower stored root reserves but creates an ideal seedbed for seeds germinating throughout the entire growing season. Mowing is ineffective and is not a recommended control method.

#### Physical Control – Prescribed Burning

Herbicide treatment in the fall followed by prescribed fire in the spring may help control leafy spurge. Fire top-kills leafy spurge but leafy spurge has the ability to sprout from the root crown and roots.

Fire may also increase leafy spurge density by stimulating sprouting of dormant buds along the extensive rhizome and root system.

Fire enhances the effect of herbicides on leafy spurge impacting the vegetative growth stimulated by burning. Picloram and 2,4-D applied in the fall after spring prescribed fire provided good control of leafy spurge seedlings within the Little Missouri National Grassland.

Burning after the application of herbicides may also control leafy spurge. In an evaluation of the combined effects of herbicide and prescribed fire conducted in Minnesota the application of picloram + 2,4-D followed by burning resulted in 100% control after two years. After the two-year period, annual grasses dominated the burned plots.

#### Biological Control – Insects/Pathogens

The U.S. Department of Agriculture has shown success using six natural enemies of leafy spurge imported from Europe. These include a stem and root-boring beetle (*Oberea erythrocephala*), four root-mining flea beetles (*Aphthona* spp.), and a shoot-tip gall midge (*Spurgia esulae*).

The flea beetles of the genus *Aphthona* are a viable biological control agent for leafy spurge. The flea beetles have persisted and reduced leafy spurge densities in Montana. *Aphthona* adults emerge from mid- to late June and induce some stress by feeding on leafy spurge foliage. Eggs are laid in early September on the soil surface near the crowns so establishment is limited in areas with extensive litter. The larvae over winter and pupate in the late spring to early summer. Stress caused by larvae feeding upon the root hairs and within the root produces the control necessary to reduce leafy spurge.

Another biological control option of leafy spurge may be fungal control. *Rhizoctonia solani* and other multinucleate *Rhizoctonia* spp. show potential. *Rhizoctonia* spp. produces stem rot at the soil line within infested areas of Montana, Colorado, and North Dakota. The fungus *Alternaria tenuissima* f. sp. *Euphorbiae* weakens leafy spurge and is a natural member of the northern Great Plains ecosystem.

#### Biological Control – Grazing

Sheep and goats provide an alternative to herbicides for controlling leafy spurge top growth in pasture and rangeland. Grazing alone will not eradicate spurge but will reduce the infestation and slow the spread of the weed. Grazing should be started early in the spring when the plant first emerges. On large infestations, areas should be divided so animals can be rotated and the entire infestation grazed in a timely manner.

#### Chemical Control

The use of herbicides (picloram + 2,4-D) with or without burning provides better control of leafy spurge than burning alone in mixed-grass prairie.

#### **Dalmatian toadflax** (*Linaria dalmatic* ssp. *dalmatica*)

This plant invades natural communities via seed and vegetative propagation (Carpenter and Murray 1998). Seed is dispersed primarily by wind, but also via livestock. The species can also spread rapidly by rhizomes (Rutledge and McLendon nd). In one season, an individual plant of toadflax can produce one to 25 floral stems, resulting in as many as 500,000 seeds per year (Carpenter and Murray 1998; CNAP 2000).



The base began a biological control program in 2004, with Dalmatian toadflax being one of the target species. The program is currently focused on controlling weeds in Crow Creek, but is expected to be expanded to other drainages in the coming years.

With respect to the proposed action, Dalmatian toadflax is documented in the areas proposed for Basin A, Basin B, Basin C, Outfall 1, the open channel near Gate 1, and Outfall 4. Distributions of Dalmatian toadflax in the areas of Outfalls 1, 2A, and 4 are shown in [Appendix A, Figures 20, 21, and 22](#). The options for control of Dalmatian toadflax (USAF 2004d) include:

#### Physical Control – Manual/Mechanical Methods

Control can be effective through the process of clean cultivation, but requires eight to 10 cultivations for the first year and four to five cultivations in the second year. Planting competitive perennial and winter annual grasses is also required. Hand pulling works for small infestations in sandy soils. This method needs to be repeated every year for five to six years to deplete the remaining root system of carbohydrate reserves. Cultivating beginning in early June and repeating every seven to 10 days for at least two to three years is another control method.

#### Biological Control – Insects/Pathogens

*Calophasia lunula*, a defoliating moth, is well established in Washington and reportedly provides some control; however, it is not considered widely effective.

#### Chemical Control

Herbicides registered for control of Dalmatian toadflax include dicamba, 2,4-D, and picloram. Picloram at two lbs/acre controlled Dalmatian toadflax for two years. Combinations of picloram at lower rates with fluroxypyr are also effective. Repeated applications of dicamba may be necessary to achieve complete control. Studies have found that the best time for application is when the carbohydrate reserves are lowest. For Dalmatian toadflax, the reserves are generally highest in the fall at the end of the growing season, and are lowest in summer, the beginning of flowering.

#### **Common hound's tongue (*Cynoglossum officinale*)**

This species spreads primarily through seed dispersal. Seeds drop on the ground and are transported on clothing or in animal fur. One plant can produce as many as 2,000 seeds. Seeds are readily dispersed, and can remain viable for two to three years if they remain on the parent plant.

With respect to the proposed action, hound's tongue is documented in the areas proposed for Outfall 1, Outfall 2A, the open channel near Gate 1, and Outfall 4. Distributions of hound's tongue in the areas of Outfalls 1, 2A, and 4 are shown in [Appendix A, Figures 23, 24, and 25](#).

There are no satisfactory means of control that specifically target hound's tongue. Hound's tongue is poisonous to domestic animals and wildlife that may graze on the plant, making grazing control methods ineffective and impractical. Hound's tongue is most associated with soil disturbance; therefore, seeding disturbed soils, use of integrated management techniques, and public awareness are the most effective means of reducing the spread and impact of the weed. In the absence of soil disturbance, hound's tongue populations decline with competition from surrounding vegetation (USAF 2004d).

### **3.12. CULTURAL AND ARCHEOLOGICAL RESOURCES**

F. E. Warren AFB, with a history extending over 130 years, is the oldest continually active military installation in the Air Force. Beginning as a military post in July 1867 when it was known as Fort D. A. Russell, the early mission of the facility was to protect the Union Pacific Railroad crews involved in the extension of the railroad. Today, one-third of the Minuteman ICBM force is based at F. E. Warren AFB. F. E. Warren AFB has approximately 220 brick structures listed in the National Register of Historic Places. Most of these facilities are located within the central core of the base, designated as a Historic District in 1969 under the provisions of the National Historic Preservation Act, and designated the Fort D. A. Russell National Historic Landmark in 1972.

The prehistoric peoples who lived in the area now occupied by F. E. Warren AFB left numerous remains and sites across the landscape that show where and how they lived. Because the base has been shielded from public development by the presence of a military installation since 1867, many of the sites have been saved from destruction. To date, approximately 200 archeological sites have been identified on F. E. Warren AFB, 71 of which are eligible or potentially eligible for inclusion in the National Register of Historic Places. No traditional cultural properties and sacred sites have been identified. Records on file at F. E. Warren AFB indicate that close to 95 percent of the base has been surveyed for archeological resources. Numerous laws, regulations, policies and guidelines apply to the archeological resources found on F. E. Warren AFB.

### **3.13. HEALTH AND SAFETY**

Unexploded Ordnance (UXO) – Portions of the northern half of the base have historically been used for firing range activities, occupying an estimated 3,000 acres. Weapons historically fired at this range include small arms, cannons, and anti-tank weapons. Almost the entire historic range is now closed with the only remaining areas still used being the baffled small arms range and an Explosive Ordnance Disposal (EOD) training area (USAF 2004b) ([Appendix A, Figure 26](#)). The proposed locations for Basins A, B, and C are within areas potentially impacted by UXO; however, the Installation Restoration Program is planning to remove UXO from the northern half of the base by the end of 2006.

Trichloroethene (TCE) – Five plumes of solvent-contaminated groundwater have been discovered on the installation. These plumes cover approximately 700 acres ([Appendix A, Figure 27](#)). Only one plume from the closed Landfill 3, containing low levels of TCE, extends slightly into an off-base private residential area commonly referred to as “Nob Hill.” This housing area is located between Happy Jack Road and Old Happy Jack Road, outside the southeastern installation boundary. The base completed a project connecting this area to the Cheyenne water system in 1997, eliminating the need to supply bottled water to the residents.

Landfills – There are four inactive landfills remaining on the installation ([Appendix A, Figure 28](#)).

#### ***Landfill 4***

Landfill 4 is located on approximately 40 acres in the southeastern corner of the base, west of Gate 2. The area was initially divided into three subunits, each identified as a separate landfill. Landfill 4a covers approximately 25 acres south of Missile Drive and northeast of Crow Creek. Part of Landfill 4a is within the Crow Creek floodplain. Landfill 4b covers roughly 11 acres north of Missile Drive and south of the railroad tracks. It is bordered on the west by Crow Creek. Landfill 4c was investigated and determined to be non-existent during the remedial investigation. Outfall 4 is proposed in close proximity to Landfill 4a.

### ***Landfill 5***

Landfill 5 is located on approximately 24 acres in the southeast corner of the base. This landfill will not be impacted by any of the components of the proposed action.

### ***Landfill 6***

Landfill 6 is located on approximately 51 acres near the western boundary of the base between Missile Drive and Diamond Creek. This landfill will not be impacted by any of the components of the proposed action.

### ***Landfill 7***

Landfill 7 comprises approximately 14 acres west of Old Glory Road between Crow Creek and Missile Drive. This landfill will not be impacted by any of the components of the proposed action.

Quantity-Distance (Q-D) Arcs – All development impacted by explosive safety zones must comply with Air Force Manual (AFMAN) 91-201, Explosive Safety Standards. The storage and handling of high explosives create unique safety hazards. To address these hazards, designated areas classified as explosive safety-quantity distance zones (designated as quantity-distance, or Q-D arcs on base maps) have been designed to safeguard the base population and civilian community from potential explosions. Within these zones, certain separation distances are mandated to minimize explosive hazards. These clear zones include the area within a safety arc surrounding an explosive storage facility and are depicted in [Appendix A, Figure 29](#).

Flooding – The outdated infrastructure on the installation contributes to flooding during major and minor storm events. The flash flood that occurred on 1 August 1985 was the result of six inches of rain that fell in approximately three hours. This storm caused 12 deaths, 70 injuries, and over \$60 million in damages. The severity of a flood depends not only on the amount of water that accumulates in a period of time, but also on the land's ability to deal with this water. One element of this is the size of rivers and streams in an area. But an equally important factor is the land's absorbency. When it rains, soil acts as a sort of sponge. When the land is saturated -- that is, has soaked up all the water it can -- any more water that accumulates must flow as runoff. Controlling and diverting the flow of this runoff upstream is an important method of minimizing the negative impacts to property and human safety resulting from a major flood event.

## **3.14. NOISE**

Existing sources of noise on the installation include fixed-wing aircraft from the Cheyenne Airport, rotary-wing aircraft from the installation's helicopter operations, the BNSF railroad, vehicle traffic on surface streets, and dispersed construction areas.

## **3.15. HAZARDOUS MATERIALS, HAZARDOUS WASTE, AND SOLID WASTE**

Hazardous materials are used throughout the base. Residues from these materials are collected at 15 Satellite Accumulation Points (SAPs). Each SAP can store up to 55 gallons of hazardous waste. The base does not accumulate acute hazardous waste. Hazardous wastes are transferred from the SAPs to the base's Hazardous Waste Characterization Site (Building 944) where they are categorized as specific wastes and prepared for shipment. After characterization, wastes are transferred to one of six hazardous waste non-permitted storage buildings (Buildings 945-941). At this point, a certified contractor has 90 days to remove the waste from the installation. Wastes are removed from these buildings at least once per month, or more frequently, if required.

F. E. Warren AFB does not manage any active solid waste landfills. Solid waste (trash) is collected, weighed, and transported to the City of Cheyenne landfill for disposal. A local contractor removes approximately 160 tons of solid waste per month from the installation's industrial areas, and 100 tons of solid waste per month from the Military Family Housing areas.

### **3.16. UTILITIES**

The Cheyenne Board of Public Utilities (BOPU) provides base water and wastewater treatment services (USAF 2004a). The Cheyenne BOPU treats all wastewater discharged by F. E. Warren AFB directly into the city's sanitary sewer system at one of two treatment plants. Western Area Power Authority and Rocky Mountain Generation Cooperative provide electrical power to the base. Natural gas is supplied to the installation by Xcel Energy.

Storm drainage structures have been installed on base at various times over the past 50 years. These systems include drainage culverts, underground storm drainage systems, roadside ditches, curbs and gutters. Unfortunately, most underground systems are undersized according to current standards. Also, many are silted-in and either partially or completely ineffective. The existing system cannot handle a 10-year design storm, a minor event, and certainly a 100-year design storm could not be controlled by existing structures.

## **4.0 ENVIRONMENTAL CONSEQUENCES**

### **4.1. PAST, PRESENT, AND REASONABLY FORESEEABLE PROJECTS**

#### **4.1.1. Past Projects**

No past projects (within the last 5 years) have been identified that will contribute to cumulative impacts, when combined with the potential impacts of the proposed action or alternatives.

#### **4.1.2. Present Projects**

One present project could contribute to cumulative impacts, when combined with the potential impacts of the proposed action or alternatives:

##### ***4.1.2.1. Freedom Elementary School***

Freedom Elementary School is currently under construction in the southern portion of base, east of the Carlin Heights Military Family Housing area. When fully constructed, the elementary school will have a footprint of approximately one acre (42,600 square feet), including space for classrooms, administrative functions, restrooms, gymnasium, cafeteria, kitchen, storage, mechanical rooms, and sufficient open space for outdoor activities (e.g., athletic fields). The structure will be constructed with a sub-slab depressurization system to vent any radon gas or TCE vapors that may volatilize under the foundation away from the building, minimizing their potential to enter the facility. Approximately 20 acres has been leased to the Laramie County School District #1 for the school.

### **4.1.3. Reasonably Foreseeable Projects**

Reasonably foreseeable projects that could contribute to cumulative impacts, when combined with the potential impacts of the proposed action or alternatives are:

#### **4.1.3.1. Military Family Housing (MFH) Privatization**

The proposed privatization initiative is intended to transfer the construction, operation and maintenance responsibilities of the MFH to a private entity for a lease term of 50 to 75 years. Responsibilities may include the construction of new housing, demolition of existing housing, renovation of existing housing, or maintenance and operation of new and existing housing. The USAF anticipates that the proposed privatization contract would include demolishing 200 inadequate structures at Capehart/MCP and constructing up to 310 new units in the areas of Capehart/MCP and Carlin Heights. Proposed construction of new MFH units in the vicinity of Carlin Heights may intercept a known cultural site. The privatization initiative is being evaluated in a separate environmental assessment.

#### **4.1.3.2. Lead-Based Paint Abatement in Historic Military Family Housing Units**

Due to the age of the historic housing on the installation, lead-based paint is present in each of the units. Certain components within the units are at issue, namely the windows, interior/exterior doors, and porches. These components have friction surfaces that create lead dust when the housing occupants use them. The ingestion of lead dust by young children has resulted in four cases, thus far, of elevated Blood Lead Levels. In addition, these components are old, which increases maintenance costs and decreases energy efficiency. The base is proposing to replace all of the existing windows with double-glazed simulated divided light windows; dip/strip and repaint all of the historic doors and trim; repair front and back porches, where possible; and remove/replace lead-contaminated soils around each of the historic housing units. The Air Force is currently negotiating the particulars of this project with various federal and state agencies. This proposed action is being evaluated in a separate environmental assessment.

#### **4.1.3.3. Consolidated Fire Department – Renovation and New Construction**

Building 323 was constructed in 1909 and comprises 10,385 square feet. Building 324 was constructed in 1909 and comprises 11,903 square feet. Status: Building 323 is used for miscellaneous storage, and Building 324 serves as the primary Fire Department. A secondary Fire Station is located in Building 1250, making Fire Department operations inefficient. Proposed work includes construction of a vehicle bay between Buildings 323 and 324, exterior modifications to connect the three facilities, and interior renovations of Buildings 323 and 324. This proposed action is being evaluated in a separate environmental assessment.

## **4.2. ALL ALTERNATIVES (EXCEPT NO ACTION)**

### **4.2.1. Land Use**

- A. *Direct and Indirect Impacts* – The areas proposed for stormwater system upgrades are currently designated as open space, and will remain open space after construction is completed. Basins A, B, and a portion of C, are proposed in areas containing Q-D arcs. Use of these sites for the purpose of stormwater drainage detention is optimal due to the restrictions for occupied facilities in these areas, thereby effectively utilizing an area with limited potential. The development opportunities associated with the remaining detention basins will be substantially limited, but this land can still be used for recreational functions. There are no anticipated adverse impacts to land use.

- B. Cumulative Impacts – This alternative, when combined with the impacts of other projects on or proximate to the base, will not significantly affect base land use patterns. The Base General Plan (USAF, 2004a) indicates that planned future land use patterns will not change significantly from existing land use configurations. Future development is not expected to adversely impact land use on the installation.

#### **4.2.2. Air Quality**

- A. Direct and Indirect Impacts – A short-term increase in fugitive dust will be generated by ground disturbing activities during construction. There will also be a short-term increase in vehicle emissions generated by construction equipment. Fugitive particulate matter emissions (i.e., dust) is estimated to be 6.4 tons each year of an estimated 3 year construction completion schedule. This estimate is based on BLM's cited emission factor of 1.2 tons per acre month of construction activities in Wyoming and assuming 80% mitigation due to watering and chemical dust suppression. Cheyenne and the surrounding area are currently in attainment for all criteria air pollutants, and these actions will not affect this status. Impacts to air quality are expected to be insignificant.
- B. Cumulative Impacts – This alternative, when combined with the impacts of other projects on or proximate to the base, will not result in significant adverse impacts to air quality.

#### **4.2.3. Health and Safety**

- A. Direct and Indirect Impacts – A long-term positive impact on health and safety is anticipated, as the proposed upgrades to the stormwater system should prevent future flooding incidents. There are no anticipated adverse impacts to health and safety associated with the proposed work.

Unexploded Ordnance (UXO) – Basins A and B, and a portion of Basin C are proposed in areas presumed to contain UXO ([Appendix A, Figure 26](#)). The Installation Restoration Program is planning to clear UXO from the northern portion of base by the end of 2006, which will be prior to the construction of these basins. If any additional UXO is discovered after work begins, work will be stopped until the installation's Explosive Ordnance Disposal (EOD) Team removes the UXO from the area. All UXO is disposed of on base.

Trichloroethene (TCE) – None of the proposed basins or associated structures will be located in areas impacted by TCE ([Appendix A, Figure 27](#)).

Landfills – Landfill 4a covers approximately 25 acres south of Missile Drive and northeast of Crow Creek. Part of Landfill 4a is within the Crow Creek floodplain. The proposed location of Outfall 4 is in close proximity to Landfill 4a, but is not expected to intercept the landfill or direct runoff over the landfill ([Appendix A, Figure 28](#)). If landfill waste will be encountered during this project, workers must receive proper training on hazardous waste operations (HAZWOPER) and all waste generated must be properly disposed off site at a disposal facility approved to accept CERCLA waste. Any waste exposed but not excavated must be re-covered with a minimum of 30 inches of soil cover. Due to the potential for UXO in the landfill, all intrusive work within the landfill boundary requires EOD oversight. No staging of equipment will be allowed on any part of the closed landfill. Positive drainage from the landfill area must be maintained during and after construction.

Quantity-Distance (Q-D) Arcs – Basins A, B, and C are proposed in areas containing Q-D arcs ([Appendix A, Figure 29](#)). Use of these sites for the purpose of stormwater drainage detention is

optimal due to the restrictions for occupied facilities in these areas, thereby effectively utilizing an area with limited potential. An Operational Risk Management (ORM) analysis must be accomplished in Basins A, B, and C and any other applicable Q-D locations prior to the start of any work.

Flooding – The proposed action is intended to have a positive impact on health and safety as they pertain to flooding and the associated hazards of flooding, such as exposure to raw sewage, injuries, and deaths.

- B. Cumulative Impacts – This alternative, when combined with the impacts of other projects on or proximate to the base, will not result in significant adverse impacts to health and safety. It is anticipated that the base and the City of Cheyenne will experience long-term positive impacts to health and safety by lessening the impacts of large flood events.

#### **4.2.4. Noise**

- A. Direct and Indirect Impacts – There will be a short-term increase in noise associated with construction activities. Due to the relatively minor noise increase, noise generated by project activities should not constitute a nuisance. The major sources of noise for this area include fixed-wing aircraft from the Cheyenne Airport, rotary-wing aircraft from the installation's flying operations, the BNSF railroad, and traffic on surface streets. Impacts to noise will be insignificant.
- B. Cumulative Impacts – This alternative, when combined with the impacts of other projects on or proximate to the base, will not result in significant adverse impacts to noise.

#### **4.2.5. Hazardous Materials, Hazardous Waste, and Solid Waste**

- A. Direct and Indirect Impacts – There will be non-hazardous construction debris generated by this project, such as cleared vegetation and other non-hazardous materials. These materials will either be recycled or disposed of at the Cheyenne City Landfill located at 1461 Happy Jack Road (ten miles west of the base). Soils excavated during construction of detention basins will be reused in the construction of berms. If unexploded ordnance is discovered during excavation activities, it will be disposed of on base. There are no anticipated impacts to hazardous materials or hazardous waste. Impacts to solid waste are expected to be insignificant.

Outfall 4 is proposed in close proximity to Landfill 4a; however, it is not anticipated that the construction of Outfall 4 will intercept any of the waste contained in the landfill. If landfill waste will be encountered during this project, workers must receive proper training on hazardous waste operations (HAZWOPER) and all waste generated must be properly disposed off site at a disposal facility approved to accept CERCLA waste. Any waste exposed but not excavated must be recovered with a minimum of 30 inches of soil cover. Due to the potential for UXO in the landfill, all intrusive work within the landfill boundary requires EOD oversight.

- B. Cumulative Impacts – This alternative, when combined with the impacts of other projects on or proximate to the base, will not result in significant adverse impacts to hazardous materials, hazardous waste, or solid waste.

#### **4.2.6. Utilities**

- A. Direct and Indirect Impacts – Locations of existing utility systems will have to be avoided during construction of the proposed action in order to avoid damage and/or outages. There are no

anticipated impacts to the sanitary sewer system, electrical distribution system, central heating system, natural gas distribution system, or communications systems. Impacts to the stormwater drainage system are expected to be positive.

- B. Cumulative Impacts – This alternative, when combined with the impacts of other projects on or proximate to the base, will not result in significant adverse impacts to utilities.

#### **4.2.7. Environmental Justice**

- A. Direct and Indirect Impacts – The proposed locations for the stormwater system upgrades are not in the vicinity of low-income or minority populations. There are no anticipated adverse impacts to low-income or minority populations.
- B. Cumulative Impacts – This alternative, when combined with the impacts of other projects on or proximate to the base, will not result in significant adverse impacts to low-income or minority populations.

#### **4.2.8. Socioeconomic Conditions**

- A. Direct and Indirect Impacts – It is anticipated that this project will have a direct positive impact on the local economy surrounding the Base. Completion of this project will result in the commitment of resources including capital, manpower, and materials. The contractor may be hired from the local community, hire local workers, and/or use local businesses for materials. Construction workers on base would likely patronize local businesses during construction. In addition, the reduction of storm water flows to downtown Cheyenne will alleviate the economic impacts to the city caused by major storm events.
- B. Cumulative Impacts – In spring of 2003, the City of Cheyenne proposed a storm water project involving a channel beginning at Carey Reservoir, crossing the golf course, and eventually exiting into Dry Creek (Wright, 2003). The F. E. Warren AFB storm water project, when combined with these improvements proposed by the city, is expected to result in a positive impact to the local economy.

### **4.3. ALTERNATIVE 1 (PREFERRED ALTERNATIVE) – CONSTRUCT NEW DETENTION BASINS, OPEN CHANNELS, AND RIP-RAPPED OUTFALLS**

#### **4.3.1. Geology, Soils, and Topography**

- A. Direct and Indirect Impacts – Ground disturbance during construction will create a short-term increase in the potential for soil erosion. The soils most widespread on F. E. Warren AFB are susceptible to wind and water erosion. Soils excavated during construction of detention basins will be reused in the construction of berms. The contractors will be required to provide erosion and sediment control measures in accordance with federal, state, and local laws and regulations. The area of bare soil exposed at any one time shall be kept to a minimum, which should substantially reduce soil erosion associated with the project. All basins will be constructed as dry basins and will be reseeded with a certified weed-free native grass mixture after construction, or landscaped appropriately if necessary. Construction of detention basins, berms, and open channels will change the topography in various locations on the installation. It is estimated that approximately 200 acres, or approximately 3.5% of the installation, will be altered by the construction of detention basins, berms, and open channels. These alterations are not expected to result in significant impacts to topography. Impacts to geology, soils, and topography are expected to be insignificant.



- B. Cumulative Impacts – This alternative, when combined with the impacts of other projects on or proximate to the base, will not significantly impact geology, soils, or topography.

#### **4.3.2. Water Resources**

- A. Direct and Indirect Impacts – A short-term increase in construction-related stormwater discharge is expected. A minor increase in sediment loads to Crow Creek is expected until vegetation in the basins becomes established. All basins will be constructed as dry basins and will be reseeded with a certified weed-free native grass mixture after construction, or landscaped appropriately if necessary. A Wyoming Pollutant Discharge Elimination System permit will be needed because construction activities will disturb more than one acre.

Water lost through evaporation from the basins has been determined to be insignificant, and no depletions to the Platte River system will occur as a result of detaining water for up to 24 hours during a 100-year storm event.

Impacts to water resources are expected to be insignificant.

- B. Cumulative Impacts – This alternative, when combined with the impacts of other projects on or proximate to the base, will not result in significant adverse impacts to water resources.

#### **4.3.3. Wetlands**

- A. Direct and Indirect Impacts – It is estimated that approximately 0.117 acres (or approximately 0.18%) of jurisdictional wetlands could be impacted by the construction of outfalls to Crow Creek. In order to provide adequate drainage for the base, storm flows must be channeled into Crow Creek, which is the primary drainage for the base and the City of Cheyenne. Thus, constructing outfalls in the floodplain is necessary, and construction in or near base wetlands is unavoidable.

Two Palustrine Emergent wetlands may be impacted by the proposed construction of outfalls to Crow Creek. Wetland #141 (consisting of 0.472 acres; [Appendix A, Figure 7](#)), which may be impacted by the construction of Outfall 1, is designated as PEMA (Palustrine Emergent, temporarily flooded). It is estimated that approximately 0.05 acres (or approximately 10.5%) of this wetland could be impacted by the construction of Outfall 1. Wetland #54 (consisting of 0.017 acres; [Appendix A, Figure 9](#)), which may be impacted by the construction of Outfall 4, is designated as PEMC (Palustrine Emergent, seasonally flooded). This wetland appears to be in the direct path of Outfall 4, and the entire 0.017 acres of this wetland could be impacted by Outfall 4.

One Palustrine Scrub-Shrub wetland may be impacted by the proposed construction of Outfall 1 to Crow Creek. Wetland #138 (consisting of 6.587 acres; [Appendix A, Figure 7](#)) is designated as PSS2C (Palustrine Scrub-Shrub, Needle-Leaved Deciduous, seasonally flooded). It is estimated that approximately 0.05 acres (or approximately 0.075%) of this wetland could be impacted by the construction of Outfall 1.

A Section 404 Permit (Clean Water Act) may be required prior to any disturbance of wetlands. Due to the limited amount of potential disturbance to wetlands on the installation, impacts are not expected to be significant.

- B. Cumulative Impacts – This alternative, when combined with the impacts of other projects on or proximate to the base, will not result in significant adverse impacts to wetlands.

#### 4.3.4. Plant Communities

- A. Direct and Indirect Impacts – Vegetation will be cleared during construction of the project components. Open areas of disturbed vegetation will be revegetated with certified weed-free seed mixtures once construction is complete. Utilizing undeveloped grasslands for Basins A, B, and C may help to preserve these grasslands by precluding future development of these areas. Components of the proposed action that are located in the more populated portions of the base may involve landscaping to screen or enhance the components. A monitoring program will be established to ensure establishment of planted vegetation. With proper best management practices in place, impacts to plant communities are expected to be insignificant.
- B. Cumulative Impacts – This alternative, when combined with the impacts of other projects on or proximate to the base, will not result in significant adverse impacts to plant communities.

#### 4.3.5. Fish and Wildlife

- A. Direct and Indirect Impacts – Temporary displacement of wildlife is expected during construction activities. Areas disturbed by construction will be reseeded with certified weed-free native grass mixtures. Wildlife is expected to return to these areas upon project completion. Pronghorn on the installation are free ranging and occur in all areas of the base, including the developed urban areas (WEST 2001b). The pronghorn on base have become accustomed to human presence and activity and are not expected to be permanently displaced by the construction activities. Some displacement of other small mammals may occur during construction of the basins. Utilizing undeveloped grasslands for Basins A, B, and C may help to preserve these grasslands by precluding future development of these areas. This will create long-term habitat for wildlife. Impacts to wildlife are expected to be insignificant.
- B. Cumulative Impacts – This alternative, when combined with the impacts of other projects on or proximate to the base, will not result in significant adverse impacts to wildlife.

#### 4.3.6. Threatened and Endangered Species

- A. Direct and Indirect Impacts – The construction of proposed Outfalls 1, 2A, and 4 to Crow Creek will disturb habitat for Preble's meadow jumping mouse and Colorado butterfly plant ([Appendix A, Figures 10 through 13](#)). The base has initiated formal consultation with the U.S. Fish and Wildlife Service via the submission of a Biological Assessment. The base is currently awaiting the Biological Opinion from the Service.

Given that flood events are a significant factor in maintaining the riparian habitat of these species, the impact of this project on the habitat can be alleviated through careful project design and implementation. If flood runoff is managed such that floodplain soils are enhanced, erosion is minimized, braided stream channels are maintained, and willow and cottonwood reproduction is encouraged, there could be short-term benefits to *Gaura*, which generally prefers early transition stage conditions, and long-term benefits to Preble's, which generally prefers late transition stage conditions (USAF 2004c). Each outfall will be constructed using large boulders interspersed with vegetation. The size of the boulders, combined with the vegetation, should allow Preble's to move through the outfalls freely, and without additional exposure to predators. In addition, the construction of outfalls is not expected to disturb *Gaura* populations. Aggressive weed management efforts will be undertaken to ensure noxious weeds are controlled. With these provisions in place, there are no anticipated adverse impacts to listed species.

- B. Cumulative Impacts – This alternative, when combined with the impacts of other projects on or proximate to the base, will not result in significant adverse impacts to threatened and endangered species.

#### **4.3.7. Noxious Weeds**

- A. Direct and Indirect Impacts – In general, ground disturbance created by construction equipment when constructing drainage basins, as well as temporary roads for access to the basins, will provide an opportunity for the increased growth and spread of noxious weeds. This increase can be alleviated through proactive control measures to 1) decrease the current weed population and 2) prohibit invasion of weeds into proposed project areas.

Canada thistle, Leafy spurge, Dalmatian toadflax, and Common hound's tongue are the most prevalent noxious weeds on F. E. Warren AFB, and are found throughout most of the areas proposed for the construction of detention basins, temporary roads, open channels, and outfalls. Extensive weed control measures will be utilized to prevent increased growth of noxious weeds in the proposed action areas. These measures will include monitoring and control of weeds before, during, and following project construction, and in areas greater than the immediate areas of disturbance. Due to the resilient nature of these noxious weeds, a combination of control measures must be used for effective control. Since each weed species reproduces and spreads differently, different control methods may be implemented for each species.

For weeds in project areas outside the vicinity of Crow Creek, a monitoring and control program will be implemented using a combination of the methods described in Section 3.11.

For weeds within the vicinity of Crow Creek, control methods will be implemented as outlined in the Conservation and Management Plan for Colorado Butterfly Plant and Preble's Meadow Jumping Mouse on F. E. Warren Air Force Base (USAF 2004c).

##### ***Outfalls 1 and 4***

Outfall 1 will be located in an area of high weed density proximate to, but not within *Gaura* habitat. Outfall 4 is located downstream from *Gaura* habitat, also in an area of high weed density. In these areas, a combination of annual goat grazing and reseeding with native species will be used to reduce the competitive advantage of weeds. Goats will be released in early May and late August/early September, and areas will be reseeded with native grass at the same time. It will be very important to work with experienced goat handlers, providing very explicit instructions relative to goat grazing in threatened species habitat, and coordinating carefully regarding the location of *Gaura* plants.

##### ***Outfall 2A***

Outfall 2 will be located in an area of Crow Creek considered high priority with regard to weeds. This area contains dense expanses of noxious weeds (primarily Canada thistle and Dalmatian toadflax), which are seedbanks for the entire riparian corridor. The best control method for this area of Crow Creek is a combination of mowing and herbicide application. In general, mowing should be done around late June (before seed formation), and herbicide should be applied around mid-September (when uptake by plants will be increased due to pre-winter root growth). The mowing/herbicide approach will require at least one mow per year. If resources allow, two mowing cycles, one in spring and one in early summer, will be more effective.

By implementing these control methods, the spread of noxious weeds should be impeded, giving native plants the chance to establish a foothold in the disturbed areas, and precluding the further establishment of noxious weeds. With the proposed monitoring and control programs in place, there are no anticipated significant impacts to the spread of noxious weeds.

Cumulative Impacts – This alternative, when combined with the impacts of other projects on or proximate to the base, will not result in significant adverse impacts to noxious weed infestations.

#### **4.3.8. Cultural and Archeological Resources**

- A. Direct and Indirect Impacts – The proposed extension of Basin I overlaps a portion of the Camp Carlin site (former Army Quartermaster depot from 1867-1890). Although the site has been disturbed before, it may contain the remains of several Camp Carlin buildings. The Camp Carlin area and the prehistoric site will be tested/surveyed to determine if any archeological remains are present. If necessary, these remains will be recovered prior to any disturbance by the proposed project. According to the Base Historic Preservation Officer, the base will test Basin I and the Camp Carlin area and if any archeological remains are found, the base will develop a data recovery [excavation] plan in consultation with the SHPO. Data recovery will alleviate any potential adverse effects to the site.

It is important that storm drainage flows be diverted away from historic resources where damage has occurred in previous storm events. Some components of the proposed action will be in or near the base's Historic District. The design agent shall ensure that historic landscape and architectural features are maintained, as well as views from the Historic District. The Historic District requires that improvements in and visible from the District be appropriate to the historic nature of the installation. Attention shall be paid to detention basins, open channels, berms, and other highly visible changes to the landscape resulting from the proposed action. The construction contractors will be put on notice that their activities may uncover additional historic or prehistoric cultural or archaeological artifacts. The contractor will be provided with and required to follow defined procedures in the event that they encounter historical, archeological, or other cultural resources during their construction activities. If, during construction activities, the contractor finds items that may be historic or cultural artifacts, work must be stopped and the Base Historic Preservation Officer notified so the potential artifacts may be examined. The Base Historic Preservation Officer will notify the contractor when project activities may be resumed.

Basin H is located within the eastern boundary of the Historic District, and was once part of the now demolished Wherry Military Family Housing area. Since the area around Basin H was previously occupied by Wherry Housing, it has been disturbed extensively in the past and there is no reason to believe it contains any archeological materials. Regardless, the construction contractor will be informed as to the correct procedure to deal with the unanticipated discovery of archeological materials. In addition, this basin is separated from the main parade ground by a road and trees, so it is visually isolated from the rest of the historic district. The existing trees are expected to be left in place during construction of the basin. As long as this basin is graded and landscaped appropriately, it should have no adverse effect on the area's historic character.

A potential archeological site (#48LA71D) is located in the area of Basin C; however, the Wyoming SHPO has determined this site to be ineligible for the National Register of Historic Places. This site will be destroyed by Basin C, but will not cause an adverse effect to a historic property.

With the proposed management practices in place, there are no anticipated adverse impacts to cultural or archeological resources. It is expected that improvements to the drainage patterns around the Officer's Quarters will result in long-term positive impacts to these structures.

- B. Cumulative Impacts – The proposed construction of new Military Family Housing units in the vicinity of Carlin Heights will disturb a known cultural site. This site will be tested and, if necessary, excavated to preserve any artifacts that may be discovered. The proposed abatement of lead-based paint hazards in the Officer's Quarters is being negotiated with various state and federal agencies. This alternative, when combined with the impacts of other projects on or proximate to the base, will not result in significant adverse impacts to cultural resources.

#### **4.4. ALTERNATIVE 2 – ELEVATED OUTFALLS**

##### **4.4.1. Geology, Soils, and Topography**

- A. Direct and Indirect Impacts – Ground disturbance during construction will create a short-term increase in the potential for soil erosion. The soils most widespread on F. E. Warren AFB are susceptible to wind and water erosion. The contractors will be required to provide erosion and sediment control measures in accordance with federal, state, and local laws and regulations. The area of bare soil exposed at any one time shall be kept to a minimum, which should substantially reduce soil erosion associated with the project. The construction area will be planted with native vegetation after construction is complete. Since water will be conveyed in a pipe, rather than over the surface of the slope, it is expected that erosion will be insignificant. Rip-rap will be placed at the pipe outlet to slow the flow of water and minimize erosion and sedimentation. Impacts to geology, soils, and topography are expected to be insignificant.
- B. Cumulative Impacts – This alternative, when combined with the impacts of other projects on or proximate to the base, will not result in significant adverse impacts to geology, soils, or topography.

##### **4.4.2. Water Resources**

- A. Direct and Indirect Impacts – Rip-rap will be placed at the pipe outlet to slow the flow of water and minimize erosion and sedimentation. The use of an elevated pipeline as an outfall structure is not expected to have any adverse impacts on water resources.
- B. Cumulative Impacts – This alternative, when combined with the impacts of other projects on or proximate to the base, will not result in significant adverse impacts to water resources.

##### **4.4.3. Wetlands**

- A. Direct and Indirect Impacts – It is estimated that approximately 0.117 acres (or approximately 0.18%) of jurisdictional wetlands could be impacted by the construction of outfalls to Crow Creek.

Two Palustrine Emergent wetlands may be impacted by the proposed construction of outfalls to Crow Creek. Wetland #141 (consisting of 0.472 acres; [Appendix A, Figure 7](#)), which may be impacted by the construction of Outfall 1, is designated as PEMA (Palustrine Emergent, temporarily flooded). It is estimated that approximately 0.05 acres (or approximately 10.5%) of this wetland could be impacted by the construction of Outfall 1. Wetland #54 (consisting of 0.017 acres; [Appendix A, Figure 9](#)), which may be impacted by the construction of Outfall 4, is designated as PEMC (Palustrine Emergent, seasonally flooded). This wetland appears to be in the direct path of Outfall 4, and the entire 0.017 acres of this wetland could be impacted by Outfall 4.

One Palustrine Scrub-Shrub wetland may be impacted by the proposed construction of Outfall 1 to Crow Creek. Wetland #138 (consisting of 6.587 acres; [Appendix A, Figure 7](#)) is designated as PSS2C (Palustrine Scrub-Shrub, Needle-Leaved Deciduous, seasonally flooded). It is estimated that approximately 0.05 acres (or approximately 0.075%) of this wetland could be impacted by the construction of Outfall 1.

A Section 404 Permit (Clean Water Act) may be required prior to any disturbance of wetlands. Due to the limited amount of potential disturbance to wetlands on the installation, impacts are not expected to be significant.

- B. Cumulative Impacts – This alternative, when combined with the impacts of other projects on or proximate to the base, will not result in significant adverse impacts to wetlands.

#### **4.4.4. Plant Communities**

- A. Direct and Indirect Impacts – Since the outfall in this alternative would be elevated, there would be a lesser amount of permanent disturbance to plant communities in the flood plain. It is proposed that the area around the pipelines be revegetated with native plants to provide cover for Preble's and stabilize the bank. Impacts to plant communities are expected to be insignificant.
- B. Cumulative Impacts – This alternative, when combined with the impacts of other projects on or proximate to the base, will not result in significant adverse impacts to plant communities.

#### **4.4.5. Fish and Wildlife**

- A. Direct and Indirect Impacts – An elevated pipeline might be a barrier to wildlife traveling the Crow Creek corridor; however, it is expected that the pipeline would be constructed to end at least 100 feet from the water's edge. There should be ample room for wildlife to pass by the pipeline. There are no anticipated adverse impacts to fish and wildlife associated with an elevated outfall.
- B. Cumulative Impacts – This alternative, when combined with the impacts of other projects on or proximate to the base, will not result in significant adverse impacts to fish and wildlife.

#### **4.4.6. Threatened and Endangered Species**

- A. Direct and Indirect Impacts – The construction of elevated Outfalls 1, 2A, and 4 to Crow Creek will disturb habitat for Preble's meadow jumping mouse and Colorado butterfly plant ([Appendix A, Figures 10 through 13](#)). The base has initiated formal consultation with the U.S. Fish and Wildlife Service via the submission of a Biological Assessment. The base is currently awaiting the Biological Opinion from the Service.

This alternative would allow for the movement of Preble's through the riparian corridor. The area around the pipeline will be revegetated with native plants to provide cover for Preble's and stabilize the bank. This alternative is not expected to disturb populations of Colorado butterfly plant. There are no anticipated impacts to endangered species. Impacts to threatened species are expected to be insignificant.

- B. Cumulative Impacts – This alternative, when combined with the impacts of other projects on or proximate to the base, will not result in significant adverse impacts to threatened and endangered species.

#### **4.4.7. Noxious Weeds**

- A. *Direct and Indirect Impacts* – In general, ground disturbance during construction of outfalls, as well as temporary roads for access to the outfalls, will provide an opportunity for the increased growth and spread of noxious weeds. This increase can be alleviated through proactive control measures to 1) decrease the current weed population and 2) prohibit invasion of weeds into proposed project areas. For weeds within the vicinity of Crow Creek, control methods will be implemented as outlined in the Conservation and Management Plan for Colorado Butterfly Plant and Preble's Meadow Jumping Mouse on F. E. Warren Air Force Base (USAF 2004c). By implementing these control methods, the spread of noxious weeds should be impeded, giving native plants the chance to establish a foothold in the disturbed areas, and precluding the further establishment of noxious weeds. With the proposed monitoring and control programs in place, there are no anticipated significant impacts to the spread of noxious weeds.
- B. *Cumulative Impacts* – This alternative, when combined with the impacts of other projects on or proximate to the base, will not result in significant adverse impacts to the spread of noxious weeds.

#### **4.4.8. Cultural and Archeological Resources**

- A. *Direct and Indirect Impacts* – The construction of elevated outfalls is not expected to disturb any known cultural or archeological sites. This alternative will not have any adverse impacts on cultural or archeological resources.
- B. *Cumulative Impacts* – This alternative, when combined with the impacts of other projects on or proximate to the base, will not result in significant adverse impacts to cultural resources.

### **4.5. ALTERNATIVE 3 – NO ACTION**

#### **4.5.1. Land Use**

- A. *Direct and Indirect Impacts* – If no action is implemented, there will be no construction of detention basins, open channels, outfalls, or berms. Under this alternative, all proposed action areas would maintain their current land use designation of open space and would be available for the future development of other base projects. Since no change in designation is anticipated, there are no anticipated impacts to land use.
- B. *Cumulative Impacts* – This alternative, when combined with the impacts of other projects on or proximate to the base, will not result in significant adverse impacts to land use.

#### **4.5.2. Geology, Soils, and Topography**

- A. *Direct and Indirect Impacts* – If no action is implemented, there will be no construction of detention basins, open channels, outfalls, or berms. Since no construction will take place, there will be no disturbance of soils, and thus no potential for additional erosion and sedimentation. Since no change to the present condition is anticipated, there are no anticipated impacts to geology, soils, or topography.
- B. *Cumulative Impacts* – This alternative, when combined with the impacts of other projects on or proximate to the base, will not result in significant adverse impacts to geology, soils, and topography.

#### **4.5.3. Air Quality**

- A. *Direct and Indirect Impacts* – If no action is implemented, there will be no construction of detention basins, open channels, outfalls, or berms. Since no construction will take place, there will be no increase in fugitive dust or vehicle emissions generated by construction equipment. Since no change to the present condition is anticipated, there are no anticipated impacts to air quality.
- B. *Cumulative Impacts* – This alternative, when combined with the impacts of other projects on or proximate to the base, will not result in significant adverse impacts to air quality.

#### **4.5.4. Water Resources**

- A. *Direct and Indirect Impacts* – If no action is implemented, there will be no construction of detention basins, open channels, outfalls, or berms. Since no construction will take place, there will be no increase in construction-related storm water discharge or sediment loads to Crow Creek. There will be no reduction in storm water flow on base, and discharge into Crow Creek will remain at its present level. Since no change to the present condition is anticipated, there are no anticipated impacts to water resources.
- B. *Cumulative Impacts* – This alternative, when combined with the impacts of other projects on or proximate to the base, will not result in significant adverse impacts to water resources.

#### **4.5.5. Wetlands**

- A. *Direct and Indirect Impacts* – If no action is implemented, there will be no construction of detention basins, open channels, outfalls, or berms, and therefore no disturbance of wetlands. Since no change to the present condition is anticipated, there are no anticipated impacts to wetlands.
- B. *Cumulative Impacts* – This alternative, when combined with the impacts of other projects on or proximate to the base, will not result in significant adverse impacts to wetlands.

#### **4.5.6. Plant Communities**

- A. *Direct and Indirect Impacts* – If no action is implemented, there will be no construction of detention basins, open channels, outfalls, or berms. Since no change to the present condition is anticipated, there are no anticipated impacts to plant communities.
- B. *Cumulative Impacts* – This alternative, when combined with the impacts of other projects on or proximate to the base, will not result in significant adverse impacts to plant communities.

#### **4.5.7. Fish and Wildlife**

- A. *Direct and Indirect Impacts* – If no action is implemented, there will be no construction of detention basins, open channels, outfalls, or berms. Since no construction will take place, there will be no disturbance to pronghorn or other small mammals due to construction activities. The proposed action areas will not be permanently designated open space, and therefore, will be available for future development. Since no change to the present condition is anticipated, there is no anticipated impact to fish and wildlife.



- B. Cumulative Impacts – This alternative, when combined with the impacts of other projects on or proximate to the base, will not result in significant adverse impacts to fish and wildlife.

#### **4.5.8. Threatened and Endangered Species**

- A. Direct and Indirect Impacts – If no action is implemented, there will be no construction of detention basins, open channels, outfalls, or berms. Since no construction will take place, there will be no disturbance of *Gaura*, Preble's, or their habitats in the vicinity of Crow Creek. Since no change to the present condition is anticipated, there are no anticipated impacts to threatened or endangered species.
- B. Cumulative Impacts – This alternative, when combined with the impacts of other projects on or proximate to the base, will not result in significant adverse impacts to threatened or endangered species.

#### **4.5.9. Noxious Weeds**

- A. Direct and Indirect Impacts – If no action is implemented, there will be no construction of detention basins, open channels, outfalls, or berms. Since no construction will take place, there will be no increase in ground disturbance, and thus no opportunity for the increased growth and spread of noxious weeds. Since no change to the present condition is anticipated, there is no impact to the spread of noxious weeds.
- B. Cumulative Impacts – This alternative, when combined with the impacts of other projects on or proximate to the base, will not result in significant adverse impacts to the spread of noxious weeds.

#### **4.5.10. Cultural and Archeological Resources**

- A. Direct and Indirect Impacts – If no action is implemented, there will be no construction of detention basins, open channels, outfalls, or berms. Since no construction will take place, there will be no disturbance or excavation of Camp Carlin or the site of Basin H. However, storm water will continue to flow into the Historic District and threaten components of the National Historic Landmark. Since this would continue to put the historic buildings at risk, no action could result in significant adverse impacts to cultural and archeological resources.
- B. Cumulative Impacts – This alternative, when combined with the impacts of other projects on or proximate to the base, could result in significant adverse impacts to cultural and archeological resources due to the additional impervious surfaces and additional stormwater runoff that may increase stormwater flows through the base and into the city.

#### **4.5.11. Health and Safety**

- A. Direct and Indirect Impacts – If no action is implemented, there will be no construction of detention basins, open channels, outfalls, or berms. The safety hazard associated with flooding would not be addressed, resulting in continued storm water flowing off base via the main gate and into downtown Cheyenne. During a major storm event, this flow could cause a repeat of the 1985 flood, which led to several deaths, injuries, and significant property damage. On F. E. Warren AFB, overtopping of bridges on base during flooding events could lead to a reduction in mission effectiveness. Therefore, this action would result in an adverse impact to health and safety.

- B. Cumulative Impacts – This alternative, when combined with the impacts of other projects on or proximate to the base, could result in significant adverse impacts to health and safety due to the additional impervious surfaces and additional stormwater runoff that may increase stormwater flows through the base and into the city.

#### **4.5.12. Noise**

- A. Direct and Indirect Impacts – If no action is implemented, there will be no construction of detention basins, open channels, outfalls, or berms, and therefore no increase in noise associated with construction activities. Since no change to the present condition is anticipated, there is no impact to noise.
- B. Cumulative Impacts – This alternative, when combined with the impacts of other projects on or proximate to the base, will not result in significant adverse impacts to noise.

#### **4.5.13. Hazardous Materials, Hazardous Waste, and Solid Waste**

- A. Direct and Indirect Impacts – If no action is implemented, there will be no construction of detention basins, open channels, outfalls, or berms. Since no construction will take place, there will be no increase in the generation of construction debris, such as soil, vegetation, or other non-hazardous materials. Since no change to the present condition is anticipated, there is no impact to solid or hazardous wastes.
- B. Cumulative Impacts – This alternative, when combined with the impacts of other projects on or proximate to the base, will not result in significant adverse impacts to solid or hazardous wastes.

#### **4.5.14. Utilities**

- A. Direct and Indirect Impacts – If no action is implemented, there will be no construction of detention basins, open channels, outfalls, or berms. Since no construction or modifications will take place, the storm sewer system on the installation will continue to be overloaded by major storm events. Impacts to the storm sewer system are expected to be negative.
- B. Cumulative Impacts – This alternative, when combined with the impacts of other projects on or proximate to the base, could result in significant adverse impacts due to the additional impervious surfaces and additional stormwater runoff.

#### **4.5.15. Environmental Justice**

- A. Direct and Indirect Impacts – If no action is implemented, there will be no construction of detention basins, open channels, outfalls, or berms. While flooding would continue to affect the City of Cheyenne, there are no anticipated impacts that would differentially affect low income or minority populations. Since no change to the present condition is anticipated, there is no impact to environmental justice.
- B. Cumulative Impacts – This alternative, when combined with the impacts of other projects on or proximate to the base, will not result in significant adverse impacts to environmental justice.

**4.5.16. Socioeconomics**

- A. Direct and Indirect Impacts – If no action is implemented, there will be no construction of detention basins, open channels, outfalls, or berms. Sustained stormwater flows to downtown Cheyenne will continue to pose an economic threat to the city during major storm events. Therefore, this action could potentially result in an adverse impact to socioeconomics.
- B. Cumulative Impacts – This alternative, when combined with the impacts of other projects on or proximate to the base, could result in significant adverse impacts to socioeconomics due to the additional impervious surfaces and additional stormwater runoff that may increase stormwater flows through the base and into the city.

## 5.0 LIST OF PREPARERS

Cathryn Pesenti Natural Resources Manager F. E. Warren AFB	Shawna Barry Natural Resources Assistant F. E. Warren AFB
William Fussinger Project Manager F. E. Warren AFB	Darren Horstmeier Chief, Base Development F. E. Warren AFB
Rick Bryant Cultural Resources Manager F. E. Warren AFB	John Wright Chief, Environmental Restoration F. E. Warren AFB
Sara Hambright Water Quality Manager F. E. Warren AFB	Leilani Woods Air Quality/Asbestos Manager F. E. Warren AFB
Laura Kwilinski Hazardous Waste Manager F. E. Warren AFB	Mike Woods Ground Safety Manager F. E. Warren AFB
Larry Bringewatt Project Manager Army Corps of Engineers, Omaha District	Rick Bollen Explosive Ordnance Disposal Team F. E. Warren AFB
Lynne Palmer EIAP Program Manager HQ Air Force Space Command	Bob Novak Chief, Environmental Planning/Conservation HQ Air Force Space Command

## 6.0 LIST OF AGENCIES, ORGANIZATIONS, AND PERSONS TO WHOM COPIES OF THE STATEMENT ARE SENT

The following agencies/individuals were contacted and/or provided a copy of the EA during its original preparation in order to afford an opportunity for comment on the content of the document. Agency consultations are required per 32 CFR 989.14(d).

Brian Kelly U. S. Fish and Wildlife Service 4000 Airport Parkway Cheyenne WY 82001	Terry Cleveland Wyoming Game and Fish Department 5400 Bishop Blvd Cheyenne WY 82006
Tom Johnson U.S. Army Corps of Engineers 2232 Dell Range Blvd, Ste 210 Cheyenne WY 82009	WY State Historic Preservation Office 2301 Central Avenue Cheyenne WY 82002
City of Cheyenne 2101 O'Neil Avenue, Room 310 Cheyenne, WY 82001	

## 7.0 REFERENCES

- About.Com: Landscaping Glossary, 2005.  
<http://landscaping.about.com/cs/lazylandscaping/g/rhizome.htm>
- Armstrong, D.M., M.E. Bakeman, N.W. Clippinger, A. Deans, M. Marseilles, C.A. Meaney, C. Miller, M. O'Shea-Stone, T.R. Ryon and M. Sanders, 1997. Report on Habitat Findings of the Preble's Meadow Jumping Mouse. Report to U.S. Fish and Wildlife Service and the Colorado Division of Wildlife. Edited by M.E. Bakeman.
- Balloffet-Entranco, 2001. Storm Drainage Investigative Survey, United States Air Force, F. E. Warren Air Force Base, June 2001.
- Beauvais, Gary P, 1998. Surveys for Preble's meadow jumping mouse (*Zapus hudsonius preblei*) on F. E. Warren Air Force Base, Wyoming, September 1998. Wyoming Natural Diversity Database, University of Wyoming, Laramie, Wyoming.
- Beauvais, Gary P, 2004. Survey for Preble's meadow jumping mice (*Zapus hudsonius preblei*) on F. E. Warren Air Force Base, Wyoming: 2003 Project Report. Wyoming Natural Diversity Database, University of Wyoming.
- Beck, G, 2003. Canada thistle. Colorado State University Cooperative Extension Natural Resources Series, No.3.108. <http://www.colostate.edu/Depts/CoopExt/PUBS/NATRES/03108.html>
- Biesboer, D.D, 1998. Element stewardship abstract for *Euphorbia esula*. The Nature Conservancy, Wildland Weeds Management and Research Program.  
<http://tncweeds.ucdavis.edu/esadocs/euphesul.html>
- Biology-Online.org: Online Biology Dictionary, 2005. [http://www.biology-online.org/dictionary.asp?Term=vegetative\\_reproduction](http://www.biology-online.org/dictionary.asp?Term=vegetative_reproduction)
- Carpenter, A.T. and T.A. Murray, 1998. Element stewardship abstract for *Linaria dalmatica*. The Nature Conservancy, Wildland Weeds Management and Research Program.  
<http://tncweeds.ucdavis.edu/esadocs.html>
- City of Cheyenne, 2005. Executive Summary, Final Recommendations for Implementing the Drainage Master Plan for the Greater Cheyenne Area. <http://www.cheyennecity.org/executiv.htm>
- Clark County Regional Flood Control District (CCRFCFCD), 2005. What Exactly Is A 100-Year Flood?  
[http://breccia.ccrfcd.org/pdf\\_arch1/floodzoneinfo/Whatis100yr.pdf](http://breccia.ccrfcd.org/pdf_arch1/floodzoneinfo/Whatis100yr.pdf)
- Colorado Natural Areas Program, 2000. Creating an Integrated Weed Management Plan. Caring for the Land Series, Volume IV. Division of Plant Industry, Colorado Department of Agriculture.
- Curry, Laura, 2003. Master's Thesis: Combining Fish and Macroinvertebrate Indices and Physical Habitat to Assess Water Quality Along a Ranchland to Urban Landuse Transition. University of Wyoming.
- Design-Build Institute of America (DBIA), 2005. <http://www.dbia.org/>

*Storm Water Drainage Project, Draft Environmental Assessment*

- Environmental Protection Agency (EPA), 2005. About the Air Quality System Database.  
<http://www.epa.gov/air/data/aqsdb.html>
- Fertig, W, 1994. Status report on *Gaura neomexicana* ssp. *coloradensis*, a candidate Threatened species.  
Wyoming Natural Diversity Database, University of Wyoming, Laramie, Wyoming.
- Fertig, W, 1998. Status review of the Colorado butterfly plant (*Gaura neomexicana* ssp. *coloradensis*).  
Wyoming Natural Diversity Database, University of Wyoming, Laramie, Wyoming.
- Fertig, W, 2000. Status review of the Colorado butterfly plant (*Gaura neomexicana* ssp. *coloradensis*).  
Wyoming Natural Diversity Database, University of Wyoming, Laramie, Wyoming.
- Garber, C, 1995. A status survey for Preble's meadow jumping mouse (*Zapus hudsonius preblei*) in  
southeastern Wyoming, including the F. E. Warren Air Force Base. Report prepared for the  
Wyoming Natural Diversity Database.
- Geotechnical Rock, Water and Resources Library, 2004. [http://www.grow.arizona.edu/Grow--  
GrowResources.php?ResourceId=208](http://www.grow.arizona.edu/Grow--GrowResources.php?ResourceId=208).
- Harris County Flood Control District, 2005. Stormwater Detention: How it works.  
<http://www.hcfcfd.org/stormwater.asp?flash=yes>
- Heidel, Bonnie and Scott Laursen, 2002. Distribution of Noxious Weeds in Riparian Corridor Habitat of  
Threatened Plant and Animal Species on F. E. Warren Air Force Base, Wyoming, January 2002.  
Wyoming Natural Diversity Database, University of Wyoming.
- Heidel, B, 2004. 16-year trends and climate correlations of a short-lived riparian species, *Gaura  
neomexicana* ssp. *coloradensis* (Onagraceae) on F. E. Warren Air Force Base. Report prepared for  
U. S. Air Force. Wyoming Natural Diversity Database, University of Wyoming, Laramie,  
Wyoming.
- Hollingsworth, C, 1996. Canada thistle (*Cirsium arvense*) and leafy spurge (*Euphorbia esula*) biological  
control program as proposed for the Colorado butterfly plant Research Natural Area on F. E. Warren  
Air Force Base. A report to the Wyoming Nature Conservancy.
- Hyperdictionary.com, 2003. <http://www.hyperdictionary.com/dictionary/braided+stream>
- Jennings, M., H. Marriott, and W. Fertig, 1997. Colorado butterfly plant (*Gaura neomexicana* ssp.  
*coloradensis*) draft recovery plan. U.S. Fish and Wildlife Service, Cheyenne, Wyoming.
- Jones, G. P, 1996. A proposed weed control program for F. E. Warren Air Force Base. Report prepared  
for the US Air Force by the Wyoming Natural Diversity Database, Laramie, WY.
- Memorandum of Understanding, 1992. Memorandum of Understanding for the Colorado butterfly plant  
*Gaura neomexicana* ssp. *coloradensis*, February 1992, between F. E. Warren Air Force Base, the  
U.S. Fish and Wildlife Service, and The Nature Conservancy.
- Metropolitan Council. ND. Minnesota Urban Small Sites BMP Manual. Detention Systems, Dry Ponds.  
[http://www.metrocouncil.org/environment/Watershed/BMP/CH3\\_STDetDryPond.pdf](http://www.metrocouncil.org/environment/Watershed/BMP/CH3_STDetDryPond.pdf)

*Storm Water Drainage Project, Draft Environmental Assessment*

National Weather Service, 30 November 2004. Glossary: 100-year Flood.

<http://www.nws.noaa.gov/glossary/index.php?letter=number>

Pochop, L., K. Warnaka, J. Borrelli, and V. Hasfurther, 1985. Design Information for Evaporation Ponds in Wyoming. Wyoming Water Research Center, University of Wyoming, Laramie, Wyoming.

Rosenlund, Bruce D, 1992. Interim F. E. Warren Air Force Base Fish and Wildlife Management Plan.

Rutledge, C.R. and T. McLendon. ND. An assessment of exotic plant species of Rocky Mountain National Park: *Euphorbia esula*. Northern Prairie Wildlife Research Center Home Page.

<http://www.npwrc.usgs.gov/resource/othrdata/Explant/explant.htm>

Ryon, T.R, 1999. Travel distance and movement patterns of the Preble's meadow jumping mouse (*Zapus hudsonius preblei*) at the Rocky Flats Environmental Technology Site. Journal of Colorado-Wyoming Academy of Science 31:12.

Schorr, R.A, 2001. Meadow jumping mice (*Zapus hudsonius preblei*) on the U.S. Air Force Academy, El Paso County, Colorado. Colorado Natural Heritage Program, Colorado State University, Fort Collins, Colorado, 53pp.

Smith Environmental, Inc, 2004. Inventory of Wetlands and Other Waters of the U.S. Within Francis E. Warren Air Force Base, Laramie County, Wyoming.

State of Connecticut, Department of Environmental Protection, 2004. 2004 Connecticut Stormwater Quality Manual. Dry Detention Ponds. [http://dep.state.ct.us/wtr/stormwater/manual/CH11\\_DD\\_S-1.pdf](http://dep.state.ct.us/wtr/stormwater/manual/CH11_DD_S-1.pdf)

State of Connecticut, Department of Environmental Protection, 2004. 2004 Connecticut Stormwater Quality Manual. Grass Drainage Channels. [http://dep.state.ct.us/wtr/stormwater/manual/CH11\\_GDS\\_S-8.pdf](http://dep.state.ct.us/wtr/stormwater/manual/CH11_GDS_S-8.pdf)

USAF, 2001. F. E. Warren AFB Storm Drainage Master Plan.

USAF, 2001. Requirements Document, FY02 Comprehensive Base Storm Drainage Project, F. E. Warren AFB WY, PDC GHLN 990002, 11 May 2001.

USAF, 2004a. Francis E. Warren Air Force Base General Plan.

USAF, 2004b. Installation Restoration Program Management Action Plan, F. E. Warren Air Force Base, October 2004.

USAF, 2004c. Conservation and Management Plan for Colorado Butterfly Plant and Preble's Meadow Jumping Mouse on F. E. Warren Air Force Base, June 30, 2004.

USAF, 2004d. Draft Invasive Plant Species Control Plan, F. E. Warren Air Force Base, Wyoming, July 2004.

USAF, 2005. F. E. Warren AFB Commander's Facts Card, Annual for Fiscal Year 2004.

U.S. Environmental Protection Agency, 2003. Nonpoint Source News-Notes, Issue 71.

<http://notes.tetrattech-ffx.com/newsnotes.nsf/0/143f7fa99c3ea25485256d0100618bc9?OpenDocument>



*Storm Water Drainage Project, Draft Environmental Assessment*

U.S. Geological Service, 2003. An assessment of exotic plant species of Rocky Mountain National Park: *Cirsium arvense*. Northern Prairie Wildlife Research Center, U.S. Geological Service.  
<http://www.npwrc.usgs.gov/resource/othrdata/Explant/cirsarve.htm>

United States Natural Resources Conservation Service, 1992. Preliminary Soil Survey, F. E. Warren AFB.

Western Ecosystems Technology (WEST), 2001a. Threatened and Endangered Species Operational Component Plan for Francis E. Warren Air Force Base.

Western Ecosystems Technology (WEST), 2001b. Fish and Wildlife Management Operational Component Plan for Francis E. Warren Air Force Base.

Wright, Eric R. Wyoming Tribune-Eagle Online, 30 June 2003. "Down the Drain."  
<http://www.wyomingnews.com/news/more.asp?StoryID=6712&arch=true>

## APPENDIX A: MAPS AND FIGURES

## APPENDIX B: TERMS AND DEFINITIONS

**100-Year Flood** – A flood so large it has a one percent chance of occurring in any given year. The term "100-year" is a measure of the size of the flood, not how often it occurs. Several 100-year floods can occur within the same year or within a few short years. Also called the base flood.

**Air Quality** – A measure of the health-related and visual characteristics of the air, often derived from quantitative measurements of the concentrations of specific injurious or contaminating substances.

**Aspect Ratio** – The ratio of width to height.

**Berm** – A low earth fill constructed in the path of flowing water to divert its direction.

**Braided Stream** – Stream that forms an interlacing network of branching and recombining channels separated by branch islands or channel bars.

**Channelization** – The process of straightening and smoothing a stream bed.

**Climate** – The average of weather over at least a 30-year period. Note that the climate taken over different periods of time (30 years, 1000 years) may be different. The old saying is climate is what we expect and weather is what we get.

**Contour** – Slope or profile of the ground.

**Conveyance** - Something that serves as a means of transportation.

**Cubic feet per second** – A unit expressing rates of discharge. One cubic foot per second is equal to the discharge through a rectangular cross section, 1 foot wide by 1 foot deep, flowing at an average velocity of 1 foot per second. It is also approximately 7.48 gallons per second.

**Cultural Resources** – Any buildings, sites, districts, structures, or objects significant in history, architecture, archeology, culture, or science.

**Culvert** – An artificial drainage channel for transporting water quickly from place to place.

**Detention Basin** – A basin that holds storm water runoff until the receiving waters are low enough for the contained water to be discharged.

**Discharge** – The volume of water that flows past a given place during a certain amount of time. Discharge is often referred to in cubic feet per second (cfs).

**Endangered Species** – A plant or animal that is in danger of extinction throughout all or a significant portion of its range. Endangered species are identified by the Secretary of the Interior in accordance with the Endangered Species Act of 1973.

**Erosion** – The wearing away of the land surface by wind or water.

**Evaporation** – The physical process by which a liquid or solid is changed to a gas.

**Flood** – The inundation of a normally dry area caused by high flow, or overflow of water in an established watercourse, such as a river, stream, or drainage ditch; or ponding of water at or near the point where the rain fell. This is a duration type event with a slower onset than flash flooding, normally greater than 6 hours.

**Hazardous Materials** – Substances that may be hazardous to health (i.e., asbestos, radon gas, lead based paint).

**Hazardous Waste** – Solid waste that exhibits one of the four characteristics of a hazardous waste (reactivity, corrosiveness, ignitability, and/or toxicity) or is specifically designated as such by the Environmental Protection Agency (EPA).

**Land Use** – The way land is developed and used in terms of the kinds of activities that occur (e.g., agriculture, residential areas, industrial areas).

**Meteorology** – The scientific study of the physics, chemistry, and dynamics of the Earth's atmosphere, especially weather and climate.

**Natural Resources** – Materials that occur in nature and are essential or useful to humans, such as water, air, land, forests, fish and wildlife, topsoil, and minerals.

**Noise** – The auditory experience of sound that lacks musical quality; sound that is a disagreeable auditory experience.

**Noxious Weed** – A plant defined by law as being especially undesirable, troublesome, and difficult to control.

**Outfall** – A structure extending into a body of water for the purpose of discharging storm water runoff.

**Plant Community** – An assembly of plants living together.

**Rhizomes** – Horizontal underground stems that strike new roots out of their nodes, down into the soil, and that shoot new stems out of their nodes, up to the surface. This rhizome activity represents a form of plant reproduction. The irrepressible nature of many of our most invasive plants is due to the vigor of their rhizomes.

**Rip-Rap** – Large stones placed on soil surfaces or stream beds to reduce erosion by flowing water.

**Runoff** – The flow of water, usually from precipitation, which is not absorbed into the ground. It flows across the land and eventually runs to stream channels, lakes, oceans, or depressions or low points in the Earth's surface. The characteristics that affect the rate of runoff include rainfall duration and intensity as well as the ground's slope, soil type, and ground cover.

**Silt** – Fine particles of soil that can be picked up by air or water and deposited as sediment.

**Solid Waste** – Solid products or materials disposed of in landfills, incinerated or composted.

**Storm Water** – Water that directly results from a rainfall event.

**Storm Sewer** – A system of pipes and/or open channels that carries storm water runoff.

*Storm Water Drainage Project, Draft Environmental Assessment*

**Threatened Species** – As defined in the Endangered Species Act, those species likely to become endangered within the foreseeable future throughout all or a significant portion of their range.

**Topography** – Physical features, such as hills, valleys, and plains that shape the surface of the earth.

**Utilities** – Services rendered by public utility companies, such as water, gas, electricity and telephone.

**Vegetative Reproduction** – Reproduction in which an organism produces one or more clones of itself, such as by fission or budding.

**Water Resources** – Water in the landscape (above and below ground) with current or potential value to the community and the environment.

**Water Quality** – The chemical, physical, and biological characteristics of water with respect to its suitability for a particular purpose; the same water may be of good quality for one purpose or use, and poor for another, depending on its characteristics and the requirements for the particular use.

**Wetland** – An area that is regularly saturated by surface water or groundwater and is characterized by a prevalence of vegetation that is adapted for life in saturated soil conditions (e.g., swamps, bogs, fens, marshes, and estuaries).

**Wildlife** – All non-domesticated and semi-domesticated mammals, birds, reptiles, and amphibians living in a natural environment, including both game species and non-game species, whether considered beneficial or otherwise.

## APPENDIX C: USFWS CORRESPONDENCE

## APPENDIX D: SHPO CORRESPONDENCE

## APPENDIX E: PUBLIC AND AGENCY COMMENTS



## APPENDIX F: RESPONSE TO COMMENTS

None required.